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EDITORIAL

THERE are still those who believe that in the treatment of pulmonary tuberculosis the two essentials are over-eating and exposure to all weathers, heat or cold, east winds, south winds, fog or snow, but the principle of rest as the essence of treatment is receiving more and more followers. Correct feeding rather than stuffing, proper ventilation rather than the haphazard exposure to the elements are required, but rest of the diseased part should form the basis of treatment in all forms of tuberculosis.

In pulmonary cases, rest in bed is often sufficient to effect a cure, even if the disease has progressed to the stage of cavitation in both lungs. But it may happen, even in the earlier stages, that the disease progresses in spite of rest in bed, and it is for this type of case that further rest is required, and so some form of collapse is indicated.

Artificial pneumothorax is still the method of choice, but if it fails other methods of collapse are being more and more employed.

There is no doubt amongst those who have experience of the treatment that many lives have been saved by collapsing the lung, and in some cases the patient appears to have been dragged from the grave by a pneumothorax or thoracoplasty. And yet it is not clear that modern collapse therapy has played an appreciable part as a causative factor in the steadily falling death-rate from tuberculosis. Patients treated by ordinary sanatorium routine do extremely well provided they can give sufficient time to the treatment. There are dangers and complications even in the most simple method of collapse, and it would seem that careful selection of cases is necessary if the undoubted benefit derived by certain individual patients is to be obtained in a series of cases. Selection is especially necessary before

thoracoplasty, but artificial pneumothorax should not lightly be undertaken. The work of Jacobæus on bronchospirometry throws much light on the working capacity of a lung partially collapsed by pneumothorax or thoracoplasty, and it is remarkable how much function may remain in a lung which appears to be more than half collapsed. Bronchospirometry is still in the experimental stage, but it may well become the most valuable method of determining the capacity of each lung. It would always be very valuable to know the vital capacity of the better lung before thoracoplasty. Among many interesting facts brought out by this work is that when a patient lies on his side the uppermost lung does less work than the other, so that a patient should lie on the healthy side in order to rest the affected lung. At present bronchospirometry is a difficult and complicated procedure, but when simplified it may well supplant the other tests of pulmonary capacity, though it is probable that the most accurate method will for many years depend on a careful examination and assessment of the patient based on clinical experience.

PROBLEMS IN APPLIED MEDICINE

THE PSYCHOLOGY OF THE TUBERCULOUS

By C. G. LEAROYD,
M.R.C.S.(ENG.), L.R.C.P.(LOND.).

HAVING lured the erudite to start reading this, let the title be hastily changed into "The State of Mind of the Tuberculous," lest one be accused of pretending to a knowledge which one does not possess.

Is there an attitude of mind characteristic of the tuberculous? Does the toxin produce anything comparable to the relentless depression of influenza, the abject apathy of ankylostomiasis, or the cunning mendacity of opium?

Surely it would be absurd to suppose that a disease that can so modify the rest of the body as to give rise to the tubercular facies would not at the same time modify the mental processes. And do we not find that those young patients, many of them cases of glandular or bony tuberculosis, who look so ethereal with their limpid eyes and long eyelashes and high colour, do tend to have mental characteristics of their own? They are gentle and kindly, enthusiastic and excitable, imaginative and amenable, and as a rule content; in fact like characters from a Sunday school story, whom unfortunately they too often imitate by dying young.

In pulmonary tuberculosis where the action of the toxin is intermittent the mental state varies, corresponding with the periodic activity of the disease. When the toxin is in large doses it produces a vivid effect.

J. B.—Young man who had seen some service in France was sent home with acute exudative disease. In the sanatorium the temperature rose to 102° every night for six weeks. Said he rather looked forward to the afternoon when his temperature began to rise, as then in imagination he sallied out into a phantom "No Man's Land" and armed with a knife or club wallowed in blood and excitement. This went on for hours night after night until he fell asleep. Later there was a sad reaction, when waking in a night-sweat, all his fiery imagining gone, he faced a depressing reality.

R. H.—Sailor with advanced bilateral disease being brought back from Australia. Ran a temperature 102° to 103° every night. Asked what he

thought about then, he said he was imagining he was helping in perilous rescues at sea. He added a significant sentence: " But it never seems to work out quite right."

Anyone who has ever had a tuberculous temperature will recognise that " Treasure Island " faithfully reproduces the tempo of his thoughts. Perhaps that explains the wonderful patience of the tuberculous; there are consolations in vivid imagery.

Fishberg gives a long list of authors and poets in whom the tuberculous toxin, we may suppose, has supplied some at any rate of the stimulus to their mental processes.

Here are two cases in whom the stopping of the supply of toxin by the arresting of the disease was coincident with the end of their literary efforts:

F. G.—Had an active apical lesion and while in this state wrote verse. Had a very " good press " and was hailed as one of the coming Georgian poets. Met by chance ten years afterwards, when the tuberculosis—and the verse—were almost forgotten. His wife said: " F. never writes now. Such a pity !" Was somewhat mollified when told he probably never would unless his lung broke down again.

D. C.—Had disease of both lungs. While in bed and under sanocrysin started writing to the papers and getting stories accepted. Envisaged a time when he could retire to a country cottage and make his living by writing. As his condition improved " rejection slips " became more frequent and finally monotonously regular. Took to chicken farming.

Probably the best thing for a tuberculous writer or artist is that he should be a " leaker "—one in whom small quantities of toxin are liberated from time to time, but never in sufficient amounts to do great harm.

There seems to me to be one characteristic of the tuberculous at all times, even in their good phases: their normal attributes, especially perhaps their expansive ones, are accentuated; the adventurous become more adventurous, the cheery more cheery, the generous more generous. Just as in G.P.I. the megalomaniacs are those patients who were always that way inclined in their normal days, the melancholics are those who were always of rather a depressed nature, while the ordinary natures in whom the cosmic rhythm brought grave and gay phases are alternately megalomaniacs and melancholics, so in tubercle the natural characteristics are enhanced.

There is one very marked type of tubercular mentality which is not nearly so common in these days of controlled temperature as it used to be: the fervid, fiery, febrile type, the extrovert with a mission and the tuberculous toxin as a compelling force within him. Many cases can be culled from history,

the records of social reform, and criminology. Probably the two last-mentioned characteristics are due to the same cause, the lowering or poisoning of the more recently acquired inhibitory mechanism or restraint. Another vaso-dilator poison, alcohol, does the same; and it has this too in common with the tubercular toxin: it renders its victim contentment.

Much has been written about the increased sexuality of the tuberculous, the old puritanical school who thought that tuberculosis was the Nemesis of sexual excess being superseded by the kindlier French school who recognised that the excess was the result of the unnatural stimulus of the toxin. This too seems to be much rarer nowadays—or at any rate it does not obtrude itself—but when it does occur it seems to have one characteristic, which is just what one would expect from a poisonous stimulus: satisfaction is never reached and desire doth outrun performance. The three cases who have been brought to my notice were all ambulant, febrile, and did not know they had the disease.

There are some who regard a certain cantankerousness, a desire to hurt, a waspishness, as part of the abnormal state of the tuberculous. But surely that is acquired through a normal psychological process. A young man with his career shattered, the brand of Naaman imagined, cabined and confined, or a married man, the clouds of financial chaos approaching him, is merely reacting normally to hard circumstance. Prisoners of war apparently did the same, the crews of ships on long voyages certainly do—and without the same excuse.

A case not altogether away from the point:

Man, advanced bilateral disease; married; 3 young children; has lost his job because of his illness. Doctor writes: "——— a bad patient temperamentally. Adopts an unreasonable attitude in worrying about his disease."

I ask you, who was unreasonable—the patient or the doctor?

GENERAL ARTICLES

ON BRONCHOSPIROMETRY

By H. C. JACOBÆUS,
M.D.,
Physician in Chief of University Clinic II. Seraphimer Hospital, Stockholm.

For a good many years I have been trying to solve the problem of how to separate the sputum from each lung in pulmonary tuberculosis.

With the aid of the bronchoscope I have tried to inject different dye solutions into the bronchi of each lung, thereby getting the sputum from each lung differently stained. As a rule I have made use of some red dye (½ per cent. fuchsin solution) on the left side and some blue dye (2 per cent. Cresylecht violet solution) on the right side. In view of the great caution which must be exercised on this type of work, I have not yet succeeded in working out a sufficiently practical method. In a few cases, however, I have managed to obtain differently coloured sputum and then to stain for tubercle bacilli, and in the special case I have in mind we were able to separate sputum with bacilli from each lung. In cases with copious sputum I have failed to obtain any useful results.

During these experiments it occurred to me that it might prove valuable were one able to separate, bronchoscopically, the air of one lung from that of the other. With this end in view I consulted our physiological expert, Professor Liljestrand, to find out what had been done by way of experiment in this line. He advised me to try applying a Plüger's rubber cuff round the distal end of the bronchoscope and connecting the other end with an ordinary Krogh's spirometer, thereby getting a record of the respiration. In the technical improvements of the method carried out later we have also had the most valuable help from Professor Liljestrand.

I then got in touch with our chief expert on bronchoscopy, Dr. Frenckner, to whom the greatest credit is due, in my opinion, for having been bold enough to try this method on man, a procedure which as late as 1930 a scientist of Hamburg with great experience of this subject had categorically declared to be impossible.

As my assistant, Dr. Björkman, had been working at ordinary spirometry for 1 to 2 years it naturally fell to his lot to carry out the equally important spirometric examination. Within a few weeks the first successful experiments on man had been concluded.

I shall pass over the various improvements made since then, but will say something about the most important results so far obtained. In addition to a preliminary communication this method has been the subject of two more extensive publications, one from the point of view of bronchoscopic technique by Dr. Frenckner and another on spirometry by Dr. Björkman.

First I should like to describe this method in a little more detail. We make use of two bronchoscopes, one of which is introduced into one of the main bronchi, generally the left one, since this runs for a longer distance without giving off any branches. The second bronchoscope ends in the trachea. Both ends of the bronchoscopes are surrounded by rubber cuffs, which are inflatable. In this manner the air in each lung is efficiently shut off. The respired air is brought from each lung to the separate spirometers, the respiratory movements being finally recorded on a kymograph, one lung above the other. In this way the respiratory movements are recorded simultaneously and are easily compared with one another.

Arrangements are made for determining the CO_2 elimination during the test.

The bronchoscopy is carried out under local anæsthesia with a 2 per cent. percain solution. One is therefore able to conduct the test without causing the patient any pain, although occasionally an uncomfortable sensation of suffocation is experienced.

Thanks to Dr. Frenckner's technical skill more than 150 tests have by now been carried out without accident, barring an occasional brief rise of temperature during the next few days.

Björkman, who has systemically tried to find out the clinical value of the method, tested in the first place ten normal cases, all medical students attached to the clinic, all of whom voluntarily placed themselves at our disposal.

The right lung has a somewhat larger share in the respiration, 53 to 56 per cent., while the left shows 44 to 47 per cent. Björkman made an experiment which was as valuable as it was original. Despite the drawbacks entailed, he tested these subjects in different postures in order to observe whether the respiration was affected thereby. It has generally been assumed that the upper lung would be breathing more than the lower compressed one. Strangely enough Björkman's experiments show that the very opposite takes place, both in regard to respiration and oxygen intake, the difference amounting to an average of 10 per cent. Several concurrent tests were made.

We think the most likely explanation is that thanks to the low blood pressure in the pulmonary circulation there is better circulation of blood through the lower lung. Possibly the diaphragm of the dependent part of the chest makes bigger excursions than in the upper part, which may also add to the difference. This may also be of some significance in pathological cases, since in pleurisy or diseased processes of one lung or the other it is of some importance on which side the patient is lying. Time does not allow me, however, to enter more closely into the question.

Before considering the utility of bronchospirometry in pathological cases I shall first say a few words about the cases themselves. Although the majority of them are pulmonary tuberculosis, there are some cases of bronchiectasis, post-pneumonic conditions, lung tumours, etc. A closer investigation of the cases from an ætiological standpoint is of less interest. The greatest interest is attached to the cases when we compare the results obtained by bronchospirometry with those obtained by physical and radiological examinations. Even if the results agree on the whole, there are some noteworthy points of difference. I will now give the records of a few cases in order to explain the practical side of this work.

Case 1.—Female aged 41. Since October, 1931, increasing cough. In March, 1932, she was found to have a right-sided pulmonary tuberculosis. Under treatment in a sanatorium where pneumothorax failed she was admitted for a possible plastic operation on October 12, 1933. General condition good. X-ray showed displacement of the heart and mediastinum to the right. In the right upper zone there was an enormous cavity and in the lower zone a diffuse indurative process. In the left lung minor changes were present in the upper part. O_2 absorption was 24·1 per cent. on the right side and 75·9 per cent. on the left side. This is rather more than one had reason to expect in assessing the condition of the lung; furthermore we found that the CO_2 elimination was much less on the right side—38·9 per cent. compared with 61·2 per cent. on the left. The ventilation on the right side was 43·6 per cent. as against 56·4 per cent. on the left. That these latter figures are so large we think is due to the enormous cavity through which a great quantity of air passes in and out without being oxygenated. It is a common phenomenon that the O_2 absorption and the CO_2 elimination do not follow one another, and we shall dicusss this in more detail later.

Case 2.—Male aged 38. In 1934 prolonged pneumonia, after which he never quite recovered. In bed since the spring, 1933. Admitted November, 1933. General condition impaired. Slight cyanosis. Tubercle bacilli present. Tuberculous laryngitis. X-ray showed bilateral changes, most marked on the right side, where there is shrinkage with displacement of heart and mediastinum. In the upper part there is an extensive cavitation. In the lower part of the lung, however, there are fairly large air-containing parts, but diminished mobility of the diaphragm. On the left side slight apical shrinkage and small opaque patches, besides suspicious cavities.

Bronchospirometric tests gave the surprising results that only 7·3 per cent. of the O_2 intake took place in the right lung and 92·7 per cent. in the left. On the other hand we find that CO_2 elimination is three times less on the right side—*i.e.*, 22·7 per cent. as against 77·3 per cent in the left lung. The ventilation follows fairly closely the CO_2 elimination, being 26·3 per cent. in the right and 73·7 per cent. in the left. In this case also the cavity formation in the right lung must be considered the cause of the great difference existing between O_2 absorption and CO_2 elimination. The practical conclusion in this case should be that the right lung is practically useless as a functioning organ and that there are good indications for a plastic operation. Unfortunately the general condition of the patient did not permit any such operation.

Case 3.—Female aged 23. Prolonged cold autumn, 1932. Since then, on and off, slight stabbing pain in the left side. Admitted for examination December 8, 1933. General condition good. Left half of chest sunken. No dulness, but on the contrary rather a hyperresonant percussion note. In front bronchial breathing with harsh inspiration and behind slightly amphoric breath sounds. There was no sputum and the sedimentation rate was 9 mm. in one hour. No obvious atelectasis, but here and there densified streaks. Heart, mediastinum and trachea were displaced to the left side. In front was a large hernia of the right lung extending as far as 1 cm. from the lateral chest wall. Diaphragm with much diminished mobility. Right lung the seat of considerable emphysema. Lipiodol examination subsequently showed cystic cavitations about the size of peas in the left lung. Bronchospirometry of the left lung gave the strange result that the oxygen absorption here was equal to nought. The CO_2 elimination and ventilation were only about 5 per cent.

Even if this is a unique case, it is a case where with our ordinary physical methods of examination we should not have been able to ascertain to what extent the patient was breathing with his left lung. Although it was reasonable to expect a considerable restriction in the breathing, the fact that it was equal to nought came as a complete surprise.

Case 4.—Male aged 28. In 1924 pleural effusion followed by seven months' pneumothorax treatment. In the summer, 1930, plastic operation on the right side. After that he kept well. X-ray October 3, 1933, showed the ordinary appearance of a right-sided posterior plastic operation with well-marked collapse of the side. It is only medially that we find a narrow layer of air-containing tissue 2 cm. broad, increasing to 6 cm. at the base. Bronchospirometry showed that 12 per cent. only of the oxygen intake takes place on the operated side. CO_2 elimination was 18·2 per cent. This case illustrates the condition present three years after thoracoplasty, thus showing that oxygen, even if of slight amount, is taken up on the operated side. Owing to the high ventilation figures in relation to the CO_2 elimination, and above all to the O_2 intake, small cavities or bronchiectatic dilatations are probably present ; the radiographs also gave some indication of this. The ventilation was unusually great—24·3 per cent. Here too we find the

reserve air (elicited on forced expiration) to be limited even to nought. The slight respiration present is just above the residual air, not a very unusual state of affairs.

CASE 5.—Female aged 20. In 1930 right-sided pneumonia for eight weeks. During 1930-32 was in a sanatorium for right-sided pneumothorax, which was maintained for eighteen months. Was then well until the spring, 1933, when cough and general debility supervened. Admitted March, 1933, for thoracoplasty. General condition rather poor. Well-marked dulness and weakened breathing over the lower half of the right lung, and pus was obtained on exploration of the pleural cavity. X-ray examination showed marked diminution of the right half of the chest with considerable displacement of the heart and mediastinum. In the upper part of the lung was a large cavity, and below the lung was completely airless. Complete thoracoplasty was performed in two stages. Bronchospirometry was carried out here twice, before and after operation. Even before the operation respiration was found to be minimal in the right lung. The O_2 intake was only 1·3 per cent. After the operation we found the O_2 absorption to have fallen to nought and the CO_2 excretion to 5·6 per cent.

Comments.

It is of interest to note that in this as also in another case bronchospirometry was carried out before as well as after the plastic operation. That the limited respiration of the diseased lung becomes still further restricted is natural, but it is of still greater interest to examine to what extent we find any change in the volume and function of the healthy lung. In both cases examined we found a reduction of the vital capacity of the sound lung by about 200 c.c., in the present case 250 c.c. This may be due to several circumstances, mostly perhaps to the fact that a previous displacement of heart and mediastinum towards the affected side ceases, the retrogression taking place at the expense of the sound lung.

Since we have only had a moderate number of pneumothorax cases for examination, our experience of this condition is fairly limited, but it is of great interest because there is no method by which we can estimate to what extent a lung treated with pneumothorax takes part in the breathing. The following cases may throw some light on the matter.

CASE 7.—Male aged 20. Taken ill acutely on July 27, 1933, with a central abscess of the right lung. On September 27 treatment by pneumothorax was initiated and the symptoms cleared up. On October 24 after twelve refills bronchospirometry was carried out in the supine position, the intrapleural pressures being 0 to 7 cm. A radiograph showed that the lung abscess seemed to be clearing up; the pneumothorax space was fairly large, the lung being reduced to considerably less than half its volume. The bronchospirometric test, however, shows a fairly satisfactory respiration in the pneumothorax lung. The O_2 intake is 18·4 per cent. and CO_2 elimination 19·5 per cent. of the total values. There were a few bouts of

cough at the end of the experiment, but only the sound lung was taking part in the coughing.

Case 8.—Male aged 34. In October, 1932, hæmoptysis in connection with a left-sided pulmonary tuberculosis. December 22, 1933, induction of pneumothorax. January 27, 1934, general condition good. X-ray examination showed left-sided pneumothorax, but there was a fairly broad adhesion passing outwards and upwards, and below this a large cavity. There was a slight displacement of heart and mediastinum to the right. In the right lung there were some streaky and mottled opacities. On bronchospirometry grey-red granulations filling up half the lumen could be seen in the left main bronchus 1½ cm. from the carina. There was slight bleeding during the test and the blood was observed partly filling up the bronchial lumina. The bronchospirometric curve gave the impression of entirely abnormal conditions. The O_2 intake was nought, and the CO_2 elimination was 8·2 per cent. from the pneumothorax lung. The vital capacity was only 420 c.c., which must be regarded as quite an abnormal value. There is not much doubt that the bronchostenosis, as also probably the bleeding, play no small part in the formation of this value. At all events respiration in this lung would seem to be much smaller than the radiograph led one to expect, whatever the cause may be.

Case 9.—Male aged 30. Admitted to sanatorium November, 1931, for right-sided pulmonary tuberculosis. Pneumothorax was induced on the right side, and at the beginning of 1932 an effusion developed and remained for nine months. In September, 1933, he got worse and developed congestion of the left lung. The next six months he was treated with bilateral pneumothorax with an improvement in his general condition. At the end of 1933 there was again an effusion on the right side. The condition became complicated at the beginning of 1934 by an effusion on the left side, and the pneumothorax on the right side was stopped. At the end of this year there was a general aggravation of the condition, which in December was as follows: Pneumothorax o.. the left side with a narrow layer of fluid extending up to the fifth rib in front. The lower parts of the lung were rather fibrous, a clearer portion being observed above. In the upper part of the right lung there was extensive infiltration with commencing liquefaction. The question now was whether thoracoplasty under the present circumstances could be performed over the right apex, and to this end one had to find out to what extent the patient used his pneumothorax lung. Bronchospirometry showed surprisingly good respiration with the pneumothorax lung. O_2 absorption was 40·7 per cent. on the left and 59·3 per cent. on the right side. CO_2 elimination and ventilation showed somewhat greater values for the left side. On ordinary spirometry the vital capacity was found to be 2 litres, thus there was no contraindication to operation. On account of the satisfactory respiration on the left side, partial thoracoplasty on the right was advised, but the patient at first refused. During the next few months the right lung became rapidly worse with increased infiltration as well as cavity formation in its upper part. His general condition also became worse, and in twenty-four hours as much as 100 to 200 c.c. of purulent sputum was brought up. During March the patient, who now

insisted on the operation, had a thoracoplasty. Progress after the thoracoplasty was excellent. The left lung was allowed to expand still further, and for the present there is decided improvement and practically no temperature. The sputum is only 10 to 20 c.c.

In this case bronchospirometry was of great practical value. It showed that the lung with the pneumothorax functioned far better than one had reason to expect, and thanks to this one ventured to carry out a plastic operation which otherwise would not have been considered.

CASE 10.—Male aged 31. Quite well until 1925, when he was taken ill while a conscript in the army. After two months the left apex was found to be tuberculous. He was under treatment for ten weeks at the Seraphimer Hospital in the spring of 1926. X-ray then showed extensive bilateral tuberculosis with the oldest changes at the left apex, where cavity formation was present. He then had sanatorium treatment for eighteen months. In the meanwhile his condition improved considerably, so that on leaving the sanatorium he was free from symptoms. During the period 1928-33 his state of health was fairly satisfactory and he was able to do a certain amount of light work.

In the spring of 1933 his condition again became worse and he was readmitted to the sanatorium. During the summer his cough increased, as did the sputum, which was generally 20 to 30 c.c. a day. He was in bed, afebrile for nearly a year. After discharge he felt comparatively well, and his condition in September, 1935, was as follows: Temperature subnormal. Sputum 10 to 50 c.c. Tubercle bacilli. No dyspnœa or cyanosis. Heart normal. Blood pressure 155/80. Abdomen and urine normal. Lungs, some dulness over the upper half left lung and right apex. Bronchovesicular breathing over the upper half of the left lung. Harsh breathing over the right lung. Numerous râles of all qualities in both lungs, mostly over the left.

X-ray showed that the left diaphragm moved somewhat less than the right and had a number of peak-shaped elevations. Heart and mediastinum moderately displaced to the left side. In the left pulmonary area were seen mottled opacities occupying the main part of the pulmonary field, and in the upper zone large cavities were seen with fluid levels.

In the middle zone of the right lung there was seen a large number of irregular, well localised calcified deposits of smaller size. In comparison with the radiographs taken in 1926 it was noticed that the changes in the left lung field have progressed while those of the right have receded, become localised and partly calcified.

On October 16 thoracoplasty was carried out. The patient developed high fever after the operation and died on November 26.

BRONCHOSPIROMETRY, OCTOBER, 1935.

	Spirometry.	*Right.*	*Left.*	*R.+L.*	*R. per Cent. Total.*	*L. per Cent. Total.*
O_2 absorption/min. ..	280·5	321·2	24·5	345·7	92·9	7·1
Ventilation/min.	5905	7090	355	7445	95·2	4·8
Vital capacity	2815	1780	445	2225	80·0	20·0

It is of interest also to note that at the autopsy there was no parenchyma capable of functioning, and yet there had been an O_2 intake of at least 7 per cent. of the total amount. Nevertheless the pathologist had had the lung for examination after the plastic operation, when it was in a stage of collapse.

CASE 11.—Female aged 27. No history of tuberculosis. In 1930 the patient was under treatment in a sanatorium for nine months for tuberculosis of the left lung. On admission she had a cough with a moderate amount of sputum containing tubercle bacilli. A pneumothorax was induced, after which the cough and sputum disappeared. The refills were continued from September until May, 1931, when they were stopped. Since then she kept well, until the spring of 1935, when she began to get paroxysmal attacks of severe pain in her back. At first the pain did not spread, but latterly they have radiated downwards to the outside of the right lung, and she was unable to lift her left leg without help. She lost 7 kilograms in weight, but had no cough or signs of renewed activity in the lungs.

October 22, 1935: X-ray examination, mediastinum and heart considerably displaced to the left. It is only in the upper lateral part of the left pulmonary field that any aerated parenchyma can be seen. No details seen in the left lung. Right lung, no abnormal shadows beyond numerous calcifications in the parenchyma. Tuberculous spondylitis of the third lumbar vertebra was seen.

BRONCHOSPIROMETRY, OCTOBER 30, 1935.

	Spirometry.	*Right.*	*Left.*	*R.+L.*	*R. per Cent. Total.*	*L. per Cent. Total.*
O_2 absorption per min. ..	216·1	303·2	63·6	366·8	82·7	17·3
CO_2 elimination	150·2	195·6	42·1	237·7	82·3	17·7
Ventilation	5085	5285	1260	6540	80·8	19·2
Vital capacity	2635	1300	275	1575	82·6	17·4

Comments.

It is surprising in this case that respiration and ventilation are as good as they are. Although the left lung had only been collapsed by pneumothorax for nine months during 1930-31, a pleural effusion had been present all the time, and on X-ray examination the whole lung was seen to be surrounded by a thick fibrous wall which apparently hampered the respiratory movements. It is also of interest that the coughing bouts were entirely absent in the affected lung or appeared very indistinctly. The respiratory position was displaced in this lung, so that the reserve air here was but 30 c.c. as compared with 520 c.c. on the healthy side.

CASE 12.—Female, aged 32. In 1914 she had double dry pleurisy and was ill for about two months. In 1915 she again had double pleurisy. In 1921 pulmonary changes were found on both sides and she was sent for treatment to a sanatorium for nine months. X-ray then showed bilateral changes with cavity formation in the left lung. She had a relapse in 1925 and had further sanatorium treatment for four months, but after that she managed her work. No further symptoms until 1932, when she felt tired and sought medical advice. Tubercle bacilli were again found, and she was admitted to a sanatorium. In November, 1934, phrenic evulsion was performed on the left side. After that the sputum was free from bacilli, but only for a few weeks.

Condition in October, 1935: General condition fair. No great dyspnœa on resting and no cyanosis. Temperature slightly raised. Extensive fibrosis in left lung and some in the upper zone of the right.

BRONCHOSPIROMETRY, OCTOBER 22, 1935.

	Spirometry.	*Right.*	*Left.*	*R.+L*	*R. per Cent. Total.*	*L. per Cent. Total.*
O_2 absorption/min. ..	186·1	228·7	38·9	267·6	85·5	14·5
CO_2 elimination	140·6	180·3	10·3	190·6	94·6	5·4
Ventilation	4230	6150	485	6635	92·7	7·3
Vital capacity	1730	1225	300	1525	80·4	19·6

The CO_2 elimination is on a relatively low level for the lung in question, whereas the O_2 intake is surprisingly good in relation to the ventilation—14·5, 7·3 per cent., a ratio which I have not seen before. This is very difficult to explain. The phrenic evulsion probably played some part with aggravation of the ventilation, while there is a great deal of parenchyma capable of functioning. The raising of the hilum and the shrinkage of the upper lobe of the lung are also likely to be significant factors.

CASE 13.—Female aged 23. At the age of 8 years she had pleurisy and was under treatment in a sanatorium for two months. Since then has been troubled with coughing, which, even if varying somewhat in intensity, has never entirely left her. She had been coughing up large quantities of green muco-purulent sputum. On severe coughing the sputum has sometimes been blood-stained. Dyspnœa on slight exertion.

At the beginning of 1935 the patient's symptoms became worse. She felt weak and tired and ran a temperature up to 100·2° F. Sputum copious, purulent and offensive, but did not contain tubercle bacilli. In better health during the summer, and in October, 1935, she had no cyanosis, the weight was maintained and the general condition was fairly good. Clubbed fingers and signs of extensive fibrosis of the left lung. X-ray examination showed the heart and mediastinum much displaced to the left, causing them to be entirely situated within the left pulmonary area. The whole of the

left lung was fibrotic and contained many cavities of various sizes. The changes were most marked in the posterior part of the lung, in the upper as well as the middle lobe. The upper lobe, at the interlobar boundary, was partially collapsed.

No opacities were seen in the right pulmonary field.

BRONCHOSPIROMETRY, NOVEMBER 1, 1935.

	Spirometry (Oct. 28 1935).	*Right.*	*Left.*	*R.+L.*	*R. per Cent. Total.*	*L. per Cent. Total.*
O_2 absorption/min. ..	187·7	266·6	4·1	270·7	98·5	1·5
CO_2 elimination	155·8	180·8	10·2	191·0	94·7	5·3
Ventilation	5110	5565	200	5765	96·5	3·5
Vital capacity	1520	1145	40	1185	96·6	3·4

Comments.

The case shows a badly diseased left lung on account of bronchiectasis and well-marked shrinking. The trachea is displaced to the left and in addition there are numerous cavities. The function of the lung is also entirely abolished. Ventilation is but 3·5 per cent. and the O_2 intake 1·5 per cent. and the vital capacity on this side 40 c.c., thus indicating a radical operation.

From the description of the above individual cases it is evident how poorly the question of absorbed O_2 secreted CO_2 and ventilation tally with one another.

Björkman has compared the relation of O_2 intake and CO_2 excretion with the ventilation and found that the CO_2 elimination accurately follows the ventilation, while the O_2 intake deviates quite considerably. It looks as if the O_2 absorption were, so to speak, a more delicate process and would be the first to be affected in the case of diseased processes. For in advanced disease of the lung the CO_2 elimination is often better maintained than the O_2 absorption. As to the explanation of this phenomenon, we shall have to await further investigations. The difference is probably due to the different physical properties of O_2 and CO_2. Since CO_2 diffuses forty times more easily through animal membranes than O_2, it stands to reason that CO_2 will be able to diffuse to some extent through the walls of bronchi or cavities.

Finally there is still another problem on which bronchospirometry has been able to throw light.

We all know that besides other means coughing plays an important part in displacing sputum from the lungs and bronchi. During the process

of bronchospirometry it not infrequently happens that the patient starts an attack of coughing, and Björkman has therefore had the opportunity, both under pathological and normal conditions, to obtain records of the coughing from each lung. As is to be expected, this cough takes the form of sudden and powerful expirations, under normal conditions equally powerful in both lungs. In the case of one lung being diseased and the air content diminished, conditions alter considerably. In one case where the patient had atelectasis of the lower right lobe and who during bronchospirometry had a violent cough nothing was recorded on the graph from the diseased lung. The patient was coughing only with his sound lung. When we come to think of it, it must be so because there is no air behind that can be expired and that can expel the sputum. The nearer the residual air is to the respiratory position the less chance is there of the patient coughing. This is also more or less the case with lungs treated by pneumothorax. The very lung in most need of getting rid of its pathological secretion has greater difficulty in dispelling by coughing the contents from the bronchi.

Moreover, it is rather peculiar that since we have learnt about these things we have had a great many unilateral lung cases in which we have been struck with the patient's difficulty in dispelling his sputum, and this we have considered due to the affected lung's inability to cough. Indeed I have seen cases of unilateral affections where the patient has been caught with a troublesome attack of coughing and one has heard the mucus rattling in the bronchi, but after a while coughing has ceased without any sputum having been dispelled. One cannot help wondering whether in such cases the sputum had not actually been forced to return to the affected lung through coughing from the sound lung. Nor does it seem to me unlikely that this difference between the two lungs in respect of their ability to cough serves more or less as a protection against spread of infection to the healthy lung.

From what has been said it will be clear that there are numerous theoretical problems of various kinds that can be elucidated through bronchospirometry. We also think we can point to valuable practical experiences gained in individual cases, experience which will surely multiply with more extensive use of the method.

SOURCES OF INFECTION IN PRIMARY TUBERCULOSIS OF CHILDHOOD

By C. H. C. TOUSSAINT,
M.R.C.S., L.R.C.P., D.P.H.,
Deputy Medical Officer of Health and Clinical Tuberculosis Officer, Metropolitan Borough of Bermondsey,

AND

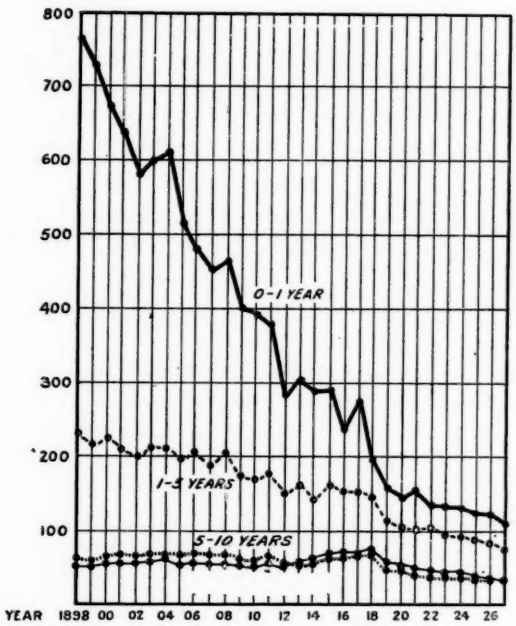
E. J. MacINTYRE,
M.D., D.P.H.,
Medical Officer of Health, Borough of Sutton and Cheam and Urban District of Banstead; late Assistant Tuberculosis Officer, Metropolitan Borough of Bermondsey.

THE object of this article is to discuss the possible origins of infection accounting for the deaths, from tuberculosis, of a number of children aged 0 to 10 years, during eight years in the Metropolitan Borough of Bermondsey. The incidence of tuberculosis in this area has, in the past, been one of the highest in the country, and tuberculous meningitis and miliary disease in infants have contributed more than their just quota to the mortality rate. When we consider the determined efforts being made to reduce infant mortality by the preservation of the weakly and the ill formed we are surprised at the lack of corresponding zeal in the protection of healthy infants from post-natal infection.

It would appear that clean milk had been crowned as the king of preventive medicine in childhood, and that the remorseless search for the tuberculous cow had diverted attention from the search for the tuberculous human.

Tuberculous meningitis and miliary tuberculosis are metastatic manifestations of tuberculous disease and not primary forms. In most cases it is possible to find, at autopsy, the primary site of infection. Those who have read the monographs of Scott[24] and of Blacklock[1] will realise the important part played by pathology in our study of primary tuberculosis in childhood. Many will recall to mind the typical findings, at autopsy, on a case of tuberculous meningitis—the lungs showing miliary tuberculosis (together maybe with other organs), the enlarged and caseating tracheo-bronchial glands, and the search for the primary focus in the lungs from which infection has eventually made its way to the meninges. It was, indeed, a demonstration on such a case by Dr. John Ryle, Regius Professor of Physic

at Cambridge, that led to the investigation now being recorded. The primary lung focus had been found and an outline was given of the path of infection from the focus to the caseating glands with a consequent generalised systemic infection. It seemed, on consideration, that surely this must have been an air-borne infection and that, if so, some person must have been responsible for this and the subsequent death of the child. A few



Rate per 100,000 living in each age group in children; under 1 year, rate per 100,000 births.

FIG. 1.—ANNUAL DEATH RATES FROM ALL FORMS OF TUBERCULOSIS FROM THE YEARS 1898-1927 AMONG CHILDREN AT DIFFERENT AGES IN ENGLAND AND WALES. (From "Tuberculosis Mortality in Children," by D. J. Dow and W. E. Lloyd, *Tubercle*, October, 1930.)

years later we were in a position to investigate this matter and will shortly record the results of the investigation.

It would be of benefit to discuss first the prevalence of this form of disease and then its ætiology.

It will be noted from Fig. 1 that since the middle of last century there has been a great fall in tuberculous mortality during infant years when, as Dow and Lloyd[6] put it, "the infectivity of the disease has full play, uncomplicated by such modifications in physiological resistance, due to

malnutrition, or wear and tear, as occur in adult years." It will be seen also from Fig. 2 that, in the present era, tuberculous meningitis is by far the most fatal form of tuberculosis in early childhood.

M'Cracken[19] in a recent Scottish investigation concludes that a very definite decrease in mortality in the early years of life has been balanced by an increase in the number of deaths attributed to tuberculous meningitis at other ages.

In spite of this fall, however, the possible reason for which we may discuss presently, there still occur two to three thousand deaths annually from miliary and meningeal tuberculosis in children under the age of 10 in England and Wales.

One feels that greater stress should be laid on the prevention of these disasters in childhood, and more especially in view of the falling birth rate.

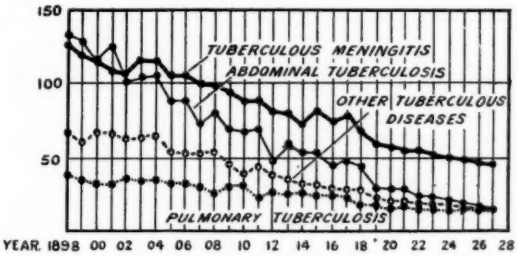


FIG. 2.—DEATH RATES FROM DIFFERENT FORMS OF TUBERCULOSIS FROM THE YEARS 1898-1927 IN CHILDREN UNDER 5 YEARS OF AGE, IN ENGLAND AND WALES. (From "Tuberculosis Mortality in Children," by D. J. Dow and W. E. Lloyd, *Tubercle*, October, 1930.)

Congenital debilities and malformations constitute a high proportion of infant deaths, but here we have children, born normal, who are immediately exposed to risk and often disaster.

During the last few years much ink has flown depicting the ravages due to the bovine bacillus. While not wishing to hinder badly needed improvements in the milk supply, with which we deal later, we cannot help feeling that deaths from tuberculosis in childhood have been used by laymen as a subtle form of propaganda in favour of wholesale pasteurisation, and that attention has thus been drawn away from sources of infection, other than milk, which may well be of far greater importance.

Griffith,[8] in 1932, published the results of bacteriological examination of bacilli obtained during life from cases of tuberculous meningitis. He found that of a total of 63 cases examined 19, or 30 per cent., were due to infection with the bovine type of bacillus. In a series of 77 fatal cases only

19·5 per cent. were due to infection with bovine bacillus. (Note that 70 and 80 per cent. respectively were infected with human type of bacilli.)

In 1934 Griffith[9] showed the results of examination in a fresh series of 188 cases of tuberculous meningitis collected from December, 1931, to December, 1933. The material used was chiefly cerebrospinal fluid withdrawn during life. Of the 188 cases of meningitis 26 per cent. yielded cultures of the bovine type of bacillus, and 74 per cent. yielded eugonic human strains. Griffith's total figures of these three investigations show that out of 328 cases only 82 or exactly 25 per cent. were due to the bovine type of bacillus and 75 per cent. to the human type.

Jensen,[14] in Denmark, in 1932 published an article in which he stated his conclusions that at the age of 5 and under, the bovine type of bacillus is responsible for exactly the same percentage of deaths, namely 25 per cent. (Here again the larger amount of infection is human in origin.)

Blacklock[1] found that of 165 children who died as a result of tuberculous disease, and from autopsies of whom the infecting organisms were isolated, the human type of bacillus was responsible for death in 72·2 per cent. and the bovine in 27·3 per cent. In cases where the primary focus was within the thorax (108 cases out of 165) bovine organisms were found in only 2·8 per cent. Hendrie[13] (1934) investigated a similar series of 300 fatal cases of tuberculosis in childhood, and found that, in 71·16 per cent., the primary focus of infection was within the thorax. He regarded this as pointing to an aerogenous mode of infection (*i.e.*, from an adult human). He considered, especially, a group of 66 cases in which fatal tuberculosis occurred during breast feeding, and 97 per cent. of these were directly traceable to aerogenous infection.

Saliou[23] (Paris, 1935) recently reported a series of 470 fatal cases of tuberculous meningitis in children aged 0 to 15. In the great majority of these there was a history of contact with a case of tuberculosis, in the active stage, with tubercle bacilli in the sputum. In only a small number of cases was the bovine type of bacillus responsible.

In America (1932) Price[22] found that of 27 cases of tuberculous meningitis in children under 14 years of age, only 1 was caused by the bovine type of bacillus.

In Australia (1932) Webster[26] examined material from 81 cases of tuberculosis in children comprising tuberculosis of (1) bones and joints, (2) cervical glands and tonsils, (3) bronchial glands and lung tissue, (4) mesenteric glands, and (5) brain and meninges. The bovine bacillus was limited to groups (2) and (4), and not in a single specimen, other

than cervical glands, tonsils or mesenteric glands, was this type of bacillus found.

It is interesting to recall that in 1928 Professor Cobbett[4] drew attention to the prevalence of the mistaken belief that tuberculosis of bones and joints (which, he pointed out, were metastatic manifestations similar to tuberculous meningitis) is caused by tubercle bacilli of bovine type in spite of the findings of the Royal Commission on Tuberculosis 1901-11, which stated that the great majority of cases of bone and joint tuberculosis were due to the human type of bacillus. Cobbett also drew attention to the work of A. S. Griffith, F. Griffith and A. Eastwood, who after investigating 598 cases of this kind found that no less than 81·3 per cent. of them were caused by tubercle bacilli of the human type.

Recently Munro and Scott[20] quoted a series of cases of tuberculous meningitis of which 60 per cent. were due to human type of bacilli and 40 per cent. to bovine type, the percentage of bovine infection being much higher in cases from rural areas. The total number of cases quoted, however, was only 38, a figure in reality too small to give rise to serious deductions.

It would seem that, if bovine tuberculosis is of the vast importance some would have us believe, much could be gleaned from the milk consumed by these children. Dr. Margaret Burns[3] has referred to the milk consumption history of 110 children, under 5 years of age, who had been notified as suffering from various non-pulmonary forms of tuberculosis. The evidence was to the effect that these cases were not associated with the consumption of large quantities of milk, but rather the reverse.

Griffith,[9] also, in relation to his last series of 188 cases, states that enquiries were made into the milk supply in the majority of the bovine cases of meningitis, with the object of tracing the source of the bovine bacilli. Such enquiries would be successful only if the interval between tuberculous infection and the occurrence of tuberculous meningitis was comparatively short, as it often is in quite young children. In a few instances enquiries led to the discovery of cows giving tuberculous milk and to the slaughter of them earlier than would otherwise have been the case, but in most cases negative results were obtained.

One can perhaps fairly summarise investigations into the occurrence of bovine infection in tuberculous meningitis by stating that these have shown 25 per cent. to be due to bovine bacilli and 75 per cent. to the human type. Various investigators have confirmed the fact that in the primary tuberculosis of childhood human infection is of far greater importance than infection with bovine type of bacillus.

Fig. 3 reveals the findings of Dow and Lloyd[6] (Brompton Hospital) and others, 1931. These authors investigated the incidence of tuberculous infection and its relation to contagion in children under 15. They found that the incidence of tuberculous infection from birth to 5 years is five times greater where there is contact with open tuberculosis than where there is no contact with the disease; that for an average working-class population more than twice as many exposed children die of tuberculosis within the first year of life as compared with the unexposed; and that the percentage death rate within the first five years of life for chil[illegible]en who have lived from birth in contact with a parent with positive sputum is 2·6 per cent. This is remarkably close to the Lancashire figure of 2·7 per cent. The Lancashire investigation[18] showed that the death rate from non-pulmonary tuberculosis,

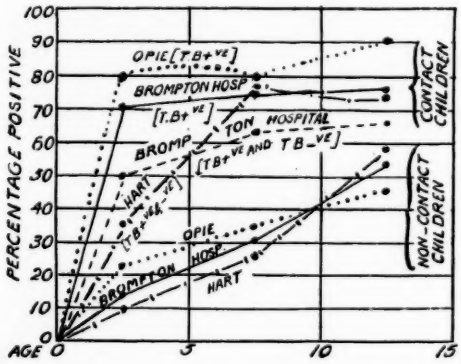


FIG. 3.—THE INCIDENCE OF TUBERCULOUS INFECTION (AS SHOWN BY MANTOUX TESTS), AND ITS RELATION TO CONTAGION IN CHILDREN UNDER 15. (D. J. Dow and W. E. Lloyd.)

(*By kind permission from the "British Medical Journal."*)

of children exposed to risk in tuberculous households from an adult with positive sputum, was greatly in excess of the rate from the same cause in the geographical county of Lancaster, serving as the control, the rate being—

Nine times greater in the age group 0 to 1.
Fourteen times greater in the age group 1 to 2.
Nineteen times greater in the age group 2 to 5.

This great excess of non-pulmonary tuberculosis was mainly due to deaths from tuberculous meningitis, which accounted for two-thirds of the mortality in the non-pulmonary group, ages 0 to 5.

Gourley,[7] an American worker, in 1934, reported the results of gastric lavage and guinea-pig inoculation with material from 59 children in the

Arroyo Sanatorium. Positive results were obtained in 28 cases, and in 24 cases of these (86 per cent. of the positive group) history of contact was obtained.

Parsons,[21] working at the Birmingham Children's Hospital, reported in 1934 that out of 671 autopsies on children under 12 years of age, in a period of less than three years, 100 cases of death from tuberculosis, chiefly tuberculous meningitis, were recorded. Investigation showed that it was generally the youngest member of a tuberculous family who developed tuberculous meningitis, the infection being with the human bacillus.

Brownlee,[2] in his investigation into the epidemiology of phthisis in Great Britain and Ireland, remarked that a definite association seems to be made out between the amount of " middle age " phthisis and the number of deaths

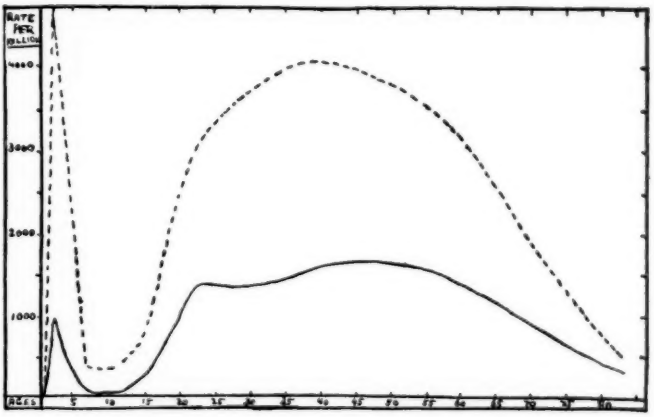


FIG. 4.

from tuberculosis in children. This is brought out in Fig. 4, the upper, dotted, line being the mortality curve (males) for 1871-80, and the lower line being the mortality curve for 1921-25. Here, we think, is shown the chief cause for the great decline in the tuberculosis mortality in children. The great majority of these children are members of tuberculous households, and as phthisis at middle age has decreased, so has the number of children exposed to risk fallen, with a consequent fall in mortality in childhood.

In addition to transmission from adult to child of the human type of bacillus, one must bear in mind the possibility of the transmission of bovine bacilli by this means—*i.e.*, by persons suffering from pulmonary tuberculosis the cause of which is a bovine type of bacillus. Such cases of pulmonary disease have been reported lately by Cumming and Foster,[5] and by Griffith

and Munro.[11] The possibility of the transmission of bovine bacilli from human to human has been discountenanced by Griffith and by Walker,[25] but Cumming[5] regards this as feasible, while Jensen[15] reports a case in which such infection was strongly presumed to have occurred.

Following the death of a child from tuberculosis, investigation of a possible human source of infection is therefore of the utmost importance, and, in an urban district, must take precedence. We are aware, not of the removal of a source of infection, as is the case when an adult dies from pulmonary tuberculosis, but of the probable existence of a new uncontrolled source. We would stress here, that in our process of investigation, nothing is available beyond peaceful persuasion of the contacts to permit of a thorough examination of themselves. Prejudice against any supposed stigma antagonises. We are as huntsmen approaching a quarry, and unless we tread warily, we will raise the alarm.

On pages 133–134 are shown the particulars of the human contacts of 80 children aged 0 to 10 who died from tuberculosis in Bermondsey during the years 1928-1935 inclusive. (These are summarised in Table A.) The causes of death were as certified to the registrar by the respective practitioners and have been copied from the death certificates. Very few of the children were seen by the Tuberculosis Officer during life, and his rôle has been to try and discover who caused the deaths of these children, and to formulate his schemes in such a way as to reduce these deaths to a minimum.

Attention is drawn in particular to Nos. 8851 (1931), 9212 (1932), and 9720 (1934). These three cases are quoted individually below.

Results of the investigation are summarised in Table A. In 26 cases complete examination of the whole family was refused. In some of these the parents agreed to the examination of other children, a futile procedure, but refused examination of themselves. Occasionally the mother would agree to an examination but not the father, or vice versa. In view of the high proportion of probable human infection shown in the remaining families, the problem might be discussed as to whether, in the last resort, examination of the contacts might not be made compulsory—*e.g.*, by application to a magistrate for an order for the examination. This would seem to be no more of a restrictive measure than the ability, now possessed by Local Authorities, to apply to a magistrate for the compulsory removal to hospital of an infective case of tuberculosis, who is considered to be a danger to others.

The probable human source of infection was found in 46 cases out of 54 in which complete investigation was possible, a very high percentage. Fathers were responsible for more than three times as many cases as mothers.

HUMAN SOURCES OF INFECTION IN PRIMARY TUBERCULOSIS OF CHILDHOOD.

Place of Death: M=Municipal Hospital, V=Voluntary Hospital, H=Home, Fev=Fever Hospital.

No.	*Initials.*	*Sex.*	*Age at Death.*	*Certified Cause of Death.*	*P.M. Exam.*	*Notified before Death.*	*Human Contact.*	*Place of Death.*
Year	1928.							
8012	A.G.	M.	4	Tub. Meningitis	No	No	Father: Pul. Tub. Sp. +	M.
8028	M.C.	F.	6	Tub. Meningitis	No	No	Two Sp. + cases in house	M.
8035	E.C.	M.	4	Tub. Meningitis	Yes	No	Refused examination	V.
8057	J.G.	M.	4	Tub. Meningitis	Yes	No	Father: Pul. Tub.	M.
8059	E.C.	M.	4	Tub. Meningitis	No	No	Refused examination	V.
8067	R.C.	F.	4 m.	Miliary Tuberculosis	Yes	No	Father: Pul. Tub. Sp. +	V.
8115	J.Y.	M.	7 m.	Miliary Tuberculosis	No	No	Mother: Pul. Tub.	M.
8161	S.H.	M.	13 m.	Miliary Tuberculosis	Yes	No	Refused examination	V.
8178	E.S.	F.	4	Tub. Meningitis	Yes	No	Father: Pul. Tub. Sp. +	V.
8180	W.K.	M.	1½	Tuberculosis of lungs	No	No	Refused examination	V.
8203	R.S.	M.	3	Tub. Meningitis	No	No	Refused examination	M.
8230	J.M.	M.	13 m.	Tub. Meningitis	No	No	Father: Pul. Tub. Sp. +	M.
8233	J.C.	M.	7 m.	Tub. Meningitis	No	No	Mother: Pul. Tub. Sp.+	M.
Year	1929							
8285	A.B.	M.	13 m.	Tub. Meningitis	No	No	Refused examination	M.
8298	A.H.	M.	14 m.	Tub. Br. Pneumonia	Yes	No	Refused examination	H.
8315	R.R.	F.	4	Tub. Meningitis	No	No	Sp. + case in house	M.
8338	E.N.	F.	2	Tub. Meningitis	No	No	Father: Pul. Tub. Sp. +	H.
8341	M.B.	F.	1	Tub. Meningitis	Yes	No	Sp. + case in house	V.
8356	A.B.	F.	8	Tub. Meningitis	No	No	Refused examination	M.
8357	R.R.	M.	2	Tub. Meningitis	No	No	Sp. + case in house	M.
8181	R.H.	M.	23 m.	Tub. Meningitis and Dactylitis	No	Yes	Father: Pul. Tub. Sp. +	M.
8344	A.B.	M.	17 m.	Tub. Meningitis	No	No	Father: Pul. Tub. Sp. +	V.
8366	H.P.	F.	6	Tub. Meningitis	No	Yes	Refused examination	M.
8368	G.S.	M.	5	Tub. Meningitis	No	No	Nil found	M.
8376	H.D.	M.	4	Tub. Meningitis	No	No	Refused examination	M.
8400	E.P.	F.	10 m.	Tub. Meningitis	No	No	Father: Pul. Tub. Sp. +	V.
8346	J.B.	F.	16 m.	General Tuberculosis	No	Yes	Refused examination	M.
8403	J.C.	F.	8 m.	Tub. Meningitis	No	No	Mother: Pul. Tub. Sp.+	M.
8492	I.W.	F.	13 m.	Tub. Meningitis	No	No	Father: Pul. Tub. Sp. +	M.
8499	D.H.	M.	2	Tub. Meningitis	Yes	No	Refused examination	V.
Year	1930							
8552	A.R.	M.	10	Tub. Meningitis	No	Yes	Refused examination	M.
8568	R.F.	F.	2	Tub. Meningitis	No	No	Father: Pul. Tub. Sp. +	M.
8596	S.H.	M.	5 m.	Tub. Meningitis	Yes	No	Father: Pul. Tub. Sp. +	V.
8605	K.F.	F.	5	Tub. Meningitis	No	No	Refused examination	M.
8624	C.S.	M.	20 m.	Tub. Br. Pneumonia	Yes	No	Father: Pul. Tub.	M.
8625	D.R.	F.	3	Tub. Meningitis	Yes	No	Brother: Pul. Tub. Sp +	V.
8634	H.B.	M.	10 m.	Miliary Tuberculosis	Yes	No	Refused examination	V.
8655	L.S.	F.	19 m.	Tub. Meningitis	Yes	Yes	Refused examination	V.
8672	O.M.	F.	19 m.	Tub. Meningitis	Yes	No	Refused examination	V.
8681	A.T.	M.	10	Tub. Meningitis	No	No	Brother: Pul. Tub. Sp.+	M.
8686	G.M.	M.	7	Tub. Meningitis	Yes	No	Refused examination	M.
8693	R.L.	M.	2	Acute Miliary Tub.	No	Yes	Father: Pul. Tub. Sp. +	M.
8707	C.C.	M.	14 m.	Tub. Meningitis	No	No	Father: Pul. Tub. Sp. +	V.
8711	N.N.	F.	13 m.	Tub. Meningitis	No	Yes	Father: Pul. Tub. Sp. +	M.
8734	S.B.	M.	3	Tub. Meningitis	No	Yes	Mother: Pul. Tub. Sp.+	M.
8770	P.T.	F.	21 m.	Tub. Meningitis	No	No	Father and Mother: Pul. Tub. Sp. +	M.

No.	*Initials.*	*Sex.*	*Age at Death.*	*Certified Cause of Death.*	*P.M. Exam.*	*Notified before Death.*	*Human Contact.*	*Place of Death.*
Year	1931							
8851	W.G.	M.	6	Tub. Meningitis	No	No	? Hospital infection	Fev.
8852	M.J.	F.	2	Miliary Tuberculosis	No	No	Refused examination	V.
8863	I.D.	F.	10	Tub. Meningitis	No	No	Nil found	M.
8865	G.A.	M.	8	Ac. Tub. Right Lung	Yes	No	Father: Pul. Tub. Sp. +	V.
8869	I.D.	F.	5	Pul. Tuberculosis Lobar Pneumonia	No	Yes	Sp. + case in house	M.
8890	E.P.	F.	2	Tub. Meningitis and Radius	No	Yes	Nil found	M.
8947	R.K.	F.	2	Tub. Meningitis	Yes	No	Refused examination	M.
8948	G.P.	M.	3	Acute Miliary Tub.	Yes	No	Refused examination	M.
8970	D.W.	F.	3	Tub. Meningitis	Yes	Yes	Refused examination	V.
8987	R.M.	F.	4	Tub. Toxæmia, Psoas abscess	Yes	No	Grandfather: Pul. Tub. Sp. +	M.
9028	E.R.	F.	6	Tub. Meningitis and Spine	No	Yes	Refused examination	H.
Year	1932							
9121	W.G.	M.	2	Tub. Meningitis	No	No	Sp. + case in house	M.
9157	D.H.	M.	6	Tub. Meningitis	Yes	No	Brother: Pul. Tub. Sp. +	V.
9206	J.C.	M.	10	Tub. Meningitis	Yes	No	Refused examination	M.
9212	E.H.	M.	4	Miliary Tuberculosis	No	Yes	Brother died. Sp. + 3 years ago	M.
Year	1933							
9313	A.M.	F.	10 m.	Tub. Meningitis	Yes	No	Refused examination	V.
9399	J.L.	F.	2	Tub. Meningitis	No	No	Mother: Pul. Tub. Sp. +	M.
9409	J.F.	F.	19 m.	Tub. Meningitis	No	No	Father: Pul. Tub. Sp. +	V.
9464	A.W.	M.	2	Tub. Meningitis	Yes	No	Sister: Pul. Tub. Sp. +	V.
9487	L.R.	M.	10 m.	Tub. Meningitis	No	Yes	Father: Pul. Tub. Sp. +	M.
9513	P.S.	M.	12 m.	Tub. Peritonitis	No	No	Father: Pul. Tub. Sp. +	H.
9556	G.T.	M.	9 m.	Tub. Br. Pneumonia	Yes	No	Father: Pul. Tub. Sp. +	V.
Year	1934							
9629	J.S.	F.	2	Tub. Meningitis	Yes	Yes	Brother: Pul. Tub. Sp. +	M.
9642	J.S.	F.	3 m.	Tub. of Abdomen	Yes	No	Mother: Pul. Tub. Sp. +	M.
9632	R.S.	F.	23 m.	Tub. Meningitis	No	Yes	Father: Pul. Tub. Sp. +	M.
9662	D.A.	M.	23 m.	Tub. Meningitis	Yes	No	Nil found	V.
9672	J.M.	F.	23 m.	Tub. Meningitis	No	No	Father: Pul. Tub. (died)	V.
9720	S.B.	F.	4	Tub. Meningitis	Yes	Yes	No family contact	M.
9748	P.P.	F.	11 m.	Tub. Meningitis	No	Yes	Nil found	M.
9757	T.R.	M.	7 m.	Miliary Tuberculosis	No	Yes	Father: Pul. Tub. Sp. +	M.
Year	1935							
9819	D.C.	F.	10	Miliary Tuberculosis	Yes	No	Refused examination	V.
9430	W.C.	M.	3	Tub. Meningitis	Yes	Yes	Father: Pul. Tub. Sp. +	M.
9860	J.E.	M.	2	Tub. Meningitis	No	Yes	Mother: Pul. Tub. Sp. +	M.
9864	B.S.	F.	4	Miliary Tuberculosis	No	Yes	Father: Pul. Tub. Sp. +	V.

TABLE A.

DEATHS FROM MILIARY OR MENINGEAL TUBERCULOSIS, 1928 TO 1935 (INCLUSIVE), BERMONDSEY, CHILDREN AGED 0 TO 10 YEARS.

Total cases	80
Contacts refused examination	26
Number of families investigated	54
Probable human source of infection found	46 (85·2 per cent.)
(Father 26, Mother 7, Both 1, Others 12)	
Possible human source of infection	3
Human source not found	5 (9·3 per cent.)

This was also found by Dow and Lloyd[6] in their investigation and by Hendrie,[13] but is in direct contrast to the findings in Lancashire,[18] where it was found that the mortality rate from tuberculosis was greater amongst the children of tuberculous positive sputum mothers than fathers.

In three cases, as mentioned above, we have noted a *possible* human source of infection:

(1) W. G., a boy aged 6, was for three months in a bed in hospital next to an older boy, P., who was slowly dying of advanced pulmonary tuberculosis. W. G. himself was not admitted for any tuberculous trouble, nor did he show any signs of it. He used, however, to perform many small services for the boy P. Later W. G. was transferred to a fever hospital, having contracted diphtheria, and while there was certified as having died of tuberculous meningitis. Full investigation of W. G.'s family revealed no other case of tuberculosis. We feel there is a strong suggestion here of infection having been contracted from the boy P. Jensen[15] records a case of subsequent occurrence of pulmonary tuberculosis in a patient, at first Pirquet negative, with negative X-ray and blood sedimentation tests, who had been placed 1½ months in a three-bedded ward whose two other inmates were sputum positive cases. We feel that hospital authorities should seriously consider the question of allowing patients with no positive evidence of tubercle to occupy the same wards as open cases.

(2) E. H., a boy aged 4, died of miliary tuberculosis. At that time there was no other case of tuberculosis in the family, but a brother (sputum positive) had died of pulmonary tuberculosis three years previously. There is here a possibility that infection had arisen from the brother, but this would allow a latent period of three years between the infection and the development of miliary tuberculosis. While this is possible the case might well be regarded as " not proven."

(3) S. B., a girl aged 4, died of tuberculous meningitis confirmed by autopsy. Investigation of the family revealed no other definite case of tuberculosis which might have infected S. B. Of three other sisters, however, two were Mantoux negative and one, G. B., was strongly positive. It transpired that of the four children only S. B., who died, and G. B. (Mantoux positive) used continually to visit an old gentleman upstairs who had a bad cough. It was not possible to secure this man's examination, and he later moved to another address, but the feeling was left that he may well have been a chronic case of pulmonary tuberculosis who had infected the two children and caused the death of one.

Infections outside the family circle must occasionally occur. Early in 1936 a girl aged 14, previously in good health, died from tuberculous meningitis. Investigation of the family showed no direct contact with a

case of tuberculosis, but it transpired that the girl used to play cards with a middle-aged man living in the same house. This man is a known "open" case of pulmonary tuberculosis, and there is a strong suspicion that he was the origin of the girl's infection.

Kirchner[17] reported a series of five cases of tuberculous meningitis or pulmonary tuberculosis in children, occurring in a district of Hesse in 1933-34 (the average number of births in this district for a year was 22), traceable to a tuberculous midwife. This woman was found to have had symptoms of bronchial catarrh for several years, and on examination tubercle bacilli were found in the sputum. She also had a sputum positive son living in the household. In addition to general carelessness it was found that she was in the habit of licking the children's comforters before use.

In five of the Bermondsey cases a human source was not found, although all members of the family were examined. Here we would again stress the need for a complete examination of both parents in such cases, including radiological examination.

Table B shows the distribution of the Bermondsey cases by sex and age. The numbers are not large and there does not appear to be any point of significance in this table, both sexes being represented fairly equally. Children aged 1 to 2 suffered to a greater extent than those of earlier age, and children aged 2 to 5 to a still greater extent. This was also noticed in the Lancashire investigation.[18]

TABLE B.

DISTRIBUTION OF CASES BY SEX AND AGE.

Age Group	0 *to* 6 *Months.*	6 *Months to* 1 *Year.*	1 *to* 2 *Years.*	2 *to* 5 *Years.*	5 *to* 10 *Years.*	*Total.*
Males	1	6	11	16	8	42
Females	2	4	10	14	8	38

Place of Death	*Voluntary Hospitals.*	*Municipal Hospitals.*	*Home.*
Total cases	28	48	4
Post-mortem examination	19 (68 per cent.)	11 (23 per cent.)	1
Notified before death	3 (11 per cent.)	18 (37·5 per cent.)	1

The lower part of the table is of some interest. The voluntary hospitals, in which is included one of the big teaching hospitals, have made greater

use of the material available for autopsy. In view, however, of the tremendous amount one can learn from such examinations, it would seem a pity that they are not performed more frequently. Much could be gained by compulsory post-mortem examinations following infantile deaths from tuberculosis, by the standardisation of findings at such examinations, and especially by the typing of cultures of the tubercle bacilli. The Tuberculosis Officer should be notified of such an examination and be granted facilities to be present.

The Medical Officers of the Municipal Hospitals, however, appear to have a greater sense of civic responsibility and have notified—in proportion —more than three times as many of these cases during life.

Early notification is of vital importance to enable the Tuberculosis Officer to investigate the source of infection. This point should be realised by the House Officers of general and children's hospitals to which the majority of these cases are taken. It should not be forgotten, however, that notification should be made only on definite evidence of tuberculous disease. There are few tuberculosis dispensaries which, in their time, have not been plagued with notifications of cases on the flimsiest of evidence, leading in the aggregate to an enormous waste of time and money. It is of course realised that in cases of tuberculous meningitis or miliary disease it is often difficult to establish a true diagnosis at an early stage. Increased use of chest radiology in such children should, however, be of considerable assistance. House Officers, also, can do much to pave the way for the Tuberculosis Officer by informing the parents that they will be requested to attend the Tuberculosis Dispensary and advising them to consent to examination of themselves and the rest of the family.

There are no doubt many of us who have burnt the midnight oil in an attempt to solve a thrilling mystery propounded for us by Dorothy Sayers, Agatha Christie, or Freeman Wills Croft. Let us now assume the part of Sherlock Holmes in an attempt to eliminate the mystery of the death of J. F., a female aged 19 months, who is reported to have died in hospital on May 6, 1933, from tuberculous meningitis. It would appear that she has been murdered just as effectively as if she had been suffocated or overlaid, and someone is responsible. Who? It is a Monday morning, in the office of the Medical Officer of Health. The weekly return of deaths has come in from the registrar of births and deaths, and contains particulars of this case. The case has not previously been notified. A copy of the registrar's return is sent to the Tuberculosis Dispensary. One of the Tuberculosis Nurses visits the home, sees Mrs. F., the mother, and persuades her to attend with the other children. They are examined by the Tuberculosis Officer and found to be healthy. In as tactful a manner as possible (for

this is the first occasion on which this family have ever come in contact with or heard of the Tuberculosis Dispensary) the Tuberculosis Officer suggests the advisability of Mr. F. attending for examination. He is at work, but can come during an evening session. He attended on May 22, 1933. On examination: Weight 11 stone 2 pounds. Nutrition good. Temperature 98°, pulse 98, slight cough, appetite good. Physical signs very indefinite. ? few creps right upper zone. Advised to send sputum for examination and to attend for X-ray. X-ray showed early infiltration and excavation in left mid zone. Sputum is positive. (This case illustrates the need for other than mere clinical examination.) This man had four months in sanatorium, gained 1 stone 7 pounds in weight, and has kept in perfect health since.

It might be asked, "Does one really achieve something in thus finding the source of infection?" We feel that the above case gives, of itself, an affirmative answer, but would like to quote an instance from another disease. A few years ago the country was visited with an epidemic of smallpox of mild type. It was of no more danger to the individual than an attack of chicken pox, but was an absolute nuisance to Public Health Authorities, and must have cost literally thousands of pounds of public money before it was stamped out. On January 16, 1930, as deputy Medical Officer of Health, one of us was asked, at about 4 p.m., by a general practitioner to see a suspected case of smallpox. He saw the patient, A, confirmed the diagnosis, and by tactful questions ascertained that a friend, B, had had spots for some time. By 9.30 that night four other cases of smallpox had been discovered—B, the originator of this little outbreak, together with C and D, brother and sister of B and infected by him, and E, a friend, also infected by B. Now these five were all members of the local Salvation Army band. This discovery led to fear of a marked extension of the trouble, but, following the prompt removal of the five to hospital, no more trouble was experienced from that quarter.

Finally we must consider the question of the prevention of tuberculosis in infancy, bearing in mind that the major problem is the danger of human infection.

There are three main lines of procedure.

Firstly immunisation of children exposed to risk—*e.g.*, by B.C.G. On this point we are of an open mind with a feeling that there may be something in it. We are guided in this by reports of Scandinavian workers who appear to be reliable and who find that B.C.G. has helped to diminish the amount of tuberculosis in children. The English official mind, however, has apparently been sceptical from the first. It can perhaps be best represented by Stanley Griffith's[10] conclusion, after his experiments on monkeys: "Vaccina-

tion with B.C.G., whether by feeding or by injection, has failed to give to monkeys the complete protection against tuberculosis reported by Wilbut, but in some instances may have produced a low grade of relative immunity."

Later, using calves, Griffith, Buxton, and Glover[12] reported that immunity of a reasonable value can be conferred by the intravenous inoculation of B.C.G. and the immunity lasts a variable time, from nearly six months to about a year, whilst a relatively less degree of immunity probably lasts longer.

Second in our methods of prevention is the boarding out of contacts. It has been shown that the incidence of infection and mortality is considerably greater amongst contact children, and the occurrence of disease would seem to depend on the size of the infecting dose and the period over which it is administered. Separation of a child from its tuberculous parent before infection has occurred will prevent the occurrence of infection, provided that the child is placed in a non-tuberculous environment.

In 1935 enquiry was made regarding 53 Bermondsey children who had been boarded out from infectious homes from 1929 to 1934. Forty-three of the 53 were well, and 10 had removed from the district. The average age was $7\frac{1}{2}$ years, and the average length of time absent from home was $6\frac{1}{2}$ months. While those who had been boarded out had remained well, these figures do not reveal the total number of children exposed to risk. We feel that the boarding out of contacts is a valuable and essential part of the tuberculosis scheme, but that attention should be focussed on the boarding out of infants. It is, unfortunately, the infant from whom the parents are least willing to be parted. It must not, however, be forgotten that the school child, in addition to the infant, may well be protected by boarding out.

The question of boarding out has been well studied and summarised recently by Gregory Kayne.[16]

Lastly, and perhaps most important of all, is the segregation in institutions, if possible, of the sputum positive cases. These must be found at as early a stage as possible, and maintained in hospital or sanatoria as long as possible. Too often we see a chronic case returned home for no other reason than that there is " no further advantage in retention." Sputum is still positive, and his presence at home may well bring death to some small child. The use of the local Municipal Hospital for the care of advanced cases is of great service in this respect, and the mere fact of a periodic visit from the Tuberculosis Officer in the hospital, with a few reassuring remarks about the rest of the family, will often keep a patient in for a prolonged time.

In our series of cases no typing of tubercle bacilli was done, but the high

proportion of human infection found in the families investigated leaves little room for doubt that these cases were human in origin. In only five cases where examination of contacts was permitted was there no evidence of human infection. For the origin of these missed cases we might be entitled to stigmatise our friend or enemy, the cow.

While emphasising the importance of human infection, steps must still be taken to further the object of a clean milk supply. The lack of a complete campaign against tuberculous cows renders pasteurisation almost essential. Veterinary staffing of large areas is still inadequate. Tuberculin reacting cows are freely marketed. Insecurity of tenure of many farmers, as a result of building development, has prevented money being spent in higher grade production of milk. There should be no unpasteurised, raw, ungraded milk. Centralised pasteurising plants under the periodic supervision of officials with engineering experience should be established.

Conclusions.

A series of 80 cases of meningeal or miliary tuberculosis is described in which strong presumption of human infection was found in the majority of instances in which complete investigation of contacts was allowed. Post-mortem examination was not sufficiently detailed in the cases investigated, or was omitted owing to the laxity of the present system of control.

No typing of the bacillus was done for a similar reason.

Examination of contacts was incomplete, but represents a good average of successes under present circumstances.

Recommendations.

A national review of deaths from tuberculosis in childhood should be instituted.

Consideration should be given to the provision of legal powers for post-mortem examinations, with standard reports of the findings and typing of the tubercle bacilli, and for the examination of contacts.

Notifications of deaths from tuberculosis in childhood should be made immediately to the Medical Officer of Health as well as to the registrar of births and deaths.

Preferential consideration, in the provision of fresh housing accommodation, should be granted to families containing open cases of pulmonary tuberculosis, and living in overcrowded conditions.

In closing, we wish to express our thanks to Dr. D. M. Connan, Medical Officer of Health for Bermondsey, who, in the early stages of this investiga-

tion, gave full support to proposals for improving the efficiency of the tuberculosis service, and to Dr. E. J. O'Keefe, now Assistant Tuberculosis Officer.

We desire also to convey our appreciation of the help given to us by the staff of the Public Health Department and of the Tuberculosis Dispensary, and, in particular, the nursing staff attached to the Dispensary. It is comparatively easy for a Tuberculosis Officer to examine and X-ray a contact who has once come into the consulting room. The difficulty lies in ensuring the attendance of that contact, and, in so far as we have been successful in our object, much of the credit is due to the nurses working at the Dispensary. Such co-operation, of course, is dependent on the dispensary nurses having a true idea of the aims and objects of the tuberculosis service apart from the mere routine of clinic work.

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CLIMATE AND TUBERCULOSIS

By ANDREW MORLAND,
M.D., M.R.C.P.,
Assistant Physician to French Hospital, Tuberculosis Officer, University College Hospital.

It is not surprising that the quality of the air breathed should have been considered important in the treatment of tuberculosis of the lungs since the earliest days of medicine. Ancient Greeks and Indians advised mountain air, but in Rome it was the fashion for consumptives to go to Egypt, although the elder Pliny considered the benefit derived to be due less to the desert climate than to the vomiting induced by the voyage to Alexandria; the same theory was put forward by Reid in 1782, and about the same time Erasmus Darwin, the grandfather of Charles, found the necessary nausea could equally well be produced with less expense by rapid rotation of a chair. Laënnec preferred the seashore and considered that the disease advanced rapidly in the mountains, but more recent French authorities hold the opposite view so strongly that they consider residence anywhere near the sea almost suicidal. In early Victorian times the tropics had a certain vogue, but it was not long before voices were raised against this practice, as the warm, damp conditions of the monsoon were found to have anything but a favourable effect. For many years Madeira was the most favoured resort, but before long it had to cede first place to Davos. Of recent years the tendency has been rather to decry climatic treatment and to try to cure the patient in or near his own home.

To get at the truth of these conflicting opinions it will be necessary to deal with the problem from several points of view. Taking first of all a rapid survey of the tuberculosis mortality in various parts of the world, the highest mortalities, about 655 per 100,000 living, are found in Manila, in the Philippine Islands and in Guayaquil in South America. Among places with mortalities between 300 and 500 are Athens, Seville and Lisbon, all sunny Southern European towns. Paris, Moscow, Dublin and Geneva come between 150 and 200. London and Berlin are both about 100. New York 70, Cape Town 68, and Sydney 50 come at the better end of the table.

Chile, Finland, Hungary, and Iceland all have tuberculosis mortalities of 200 per 100,000 or over; Norway, France, and Spain are between 150 and 200; Switzerland, Sweden, and Italy from 100 to 150. The lowest mortali-

ties in Europe are in the British Isles, the Netherlands, and Denmark, all countries bordering on the North Sea. The United States, Ceylon, Australia, South Africa, and New Zealand also have mortalities under 100.

If mortalities are studied in greater detail it appears that in France the highest rates are found in Brittany (*see* Table); Ichok[1] has concluded from this that the maritime climate exerts an unfavourable influence on phthisis. His views have been widely accepted in France, but it is doubtful whether his conclusions are correct. In the first place the seashore of the southern half of the Bay of Biscay has a low tuberculosis mortality; in explanation of this the Celtic race has been supposed by some to be unduly susceptible.

	Auvergne.	*Gironde.*	*Mediterranean.*	*Rhône Valley.*	*Parisian.*	*Breton.*
Total	1·3	1·2	1·5	1·4	1·7	2·1
Towns	1·8	2·0	2·0	1·7	1·9	3·0
Country Districts ..	1·0	1·1	1·1	1·3	1·3	1·8

There is another possible explanation: Laënnec, a man of exceptional powers of observation, noticed that the inhabitants of the Breton Coast were comparatively *immune* from tuberculosis; he was so much impressed by this observation that he used to bring bundles of seaweed back to Paris with him and put them under his patient's beds, hoping that their marine aroma would have a therapeutic effect. It seems possible, therefore, that in his time the incidence of tuberculosis in France was the reverse of what it is now. Stokes, the famous Dublin physician of a century ago, also favoured the mild, damp Atlantic climate and used to send his patients to the south-west of Ireland. Although this seems absurd to us, the comparative incidence of the disease at the time certainly fitted in with his views. Whereas the tuberculosis death-rate has been steadily falling in England and Scotland, at any rate since the middle of last century, Ireland, which had the lowest mortality until 1880, did not reach its maximum until about 1900. Still more striking changes have taken place in Sweden.[2] A hundred years ago the highest tuberculosis mortality (over 300) was found in the neighbourhood of Stockholm, whereas the rural northern provinces gave figures which were only about half as great. Of recent years the position has been reversed and the urban districts near the capital have reduced their tuberculosis death-rate to the neighbourhood of 100 per 100,000; the extreme northern province of Norrland, on the other hand, had a rate of over 300 from 1911 to 1920, but this is now falling.

In New York, where immigrants from many countries are transformed

in the course of a few decades into 100 per. cent. Americans, interesting differences are found when the tuberculosis mortality rates are classified according to the country of origin (Fig. 1). Although a medical examination has to be passed, it is noteworthy that the Irish immigrants suffer just as high a tuberculosis mortality in the sunny, dry climate of New York as their compatriots do in the humid atmosphere of Ireland. The Jews in American cities, also the Copts in Egypt, show a remarkable immunity which is no doubt attributable to the fact that for centuries these communities have been cooped up in overcrowded areas of great cities. Fishberg[3] was probably correct when he said that " one human race or group, when first encountering the tubercle bacillus, is as vulnerable as another; it is only after they have been exposed for many generations that they acquire a certain degree of resistance."

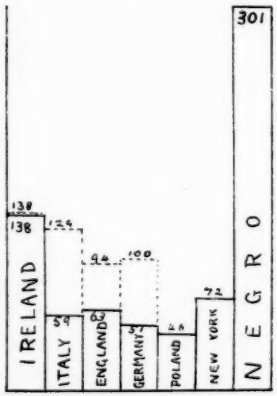

FIG. 1.—NEW YORK: TUBERCULOSIS MORTALITY ACCORDING TO COUNTRY OF ORIGIN (1930–1).

Social status also affects the incidence of tuberculosis; for instance, in the United States (1930) physicians and surgeons only suffered a mortality of 24 per 100,000 as compared with 185 for unskilled labourers. Countries such as England, Germany, and Holland, which have a large middle class, can therefore be expected to have a lower tuberculosis mortality than more backward countries such as Spain and Greece.

Gardner[4], Webb, and Ryder, find a definite correlation in the United States between altitude, humidity, and tuberculosis mortality, but in general it must be admitted that climatic factors only play a subordinate rôle in the variations in the tuberculosis mortality rates in different parts of the world.

Possibly the study of local differences may prove more fruitful. In 1895 the Sanitary Department of the Canton Grisons investigated the incidence of tuberculosis amongst the native population at various elevations above sea-level (Fig. 2). This shows a steady diminution in the prevalence of tuberculous disease with increasing altitude.

Gordon,[5] in his studies on " The Influence of Strong Rain-Bearing Winds on the Prevalence of Phthisis in Devon, Derby, and Shropshire," found a mortality of 69·6 amongst those living in sheltered situations as compared with just over twice that rate (141·3) in exposed positions. Damp houses and soil appeared to be less important than exposure to the full force of the south-west wind immediately outside the house.

The influence of smoke-laden atmospheres on acute and chronic lung affections was studied in America by Hinsdale,[6] and the rather surprising conclusion is reached that particularly foggy winters, although having a high incidence of pneumonia, show a decline in tuberculosis. Sir Leonard Rogers[7] has shown that this curious antagonism between tuberculosis and pneumonia is also noticeable in India, where the latter disease is most common in the dry desert regions and comparatively infrequent in the humid atmosphere of Madras, where tuberculosis is particularly prevalent.

Turning now to the question of climatic treatment for the tuberculous, we reach a subject on which a vast amount has been written, much of which is unfortunately not of great scientific value. Naturally every place wants to get the best type of case, and we find health resorts from the shores of the Baltic to the High Alps or the Atlantic islands all clamouring for cases of early or incipient phthisis, in which they claim good results. With monotonous regularity we read in prospectuses that only cases with advanced

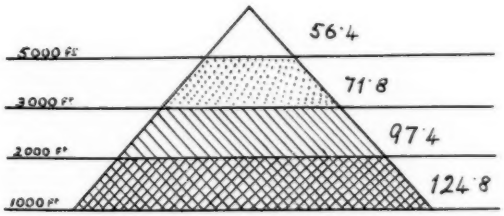

FIG. 2.—INFLUENCE OF ALTITUDE ON TUBERCULOSIS MORTALITY. (HUGGARD, 1906.)

disease with laryngeal and intestinal complications or with severe cardiac or renal troubles cannot be expected to benefit. In contrast to this sort of thing the late Dr. Huggard[8] of Davos, in his book on climatic treatment, wrote that in choosing a climate for any individual patient the stage of the disease and the extent of it are relatively unimportant, the prime consideration being to find that climate in which the patient's nutrition is at its highest level. In proceeding to discuss the characteristics of various climatic regions I think it is important to keep constantly in mind another of Dr. Huggard's sayings: "Whether a climate is bracing or relaxing depends mainly on the patient's power of response: for metabolism to be increased the digestive organs must be in good enough order to respond to a demand for increased activity of function."

Although there are other important factors, such as the amount of sunshine, climatic treatment depends in the main on putting the patient in an environment which either stimulates or retards his metabolism. The metabolic

rate is increased by such factors as low temperatures, wind and dryness of the air, the last named acting by facilitating evaporation not only from the surface of the body but also from the lungs. When the outside temperature approximates to that of the body and when the air is saturated with water vapour far less fuel has to be burned than when the body temperature has to be maintained on a dry, frosty day with an east wind blowing. Although many of us feel more comfortable in a stuffy atmosphere, there is no doubt that the great majority of us are improved in health by more bracing surroundings. In no disease has this fact been more clearly illustrated than in the case of tuberculosis; in the days when consumptives were treated in warm, draught-proof rooms recovery was exceptional. Since fresh air has been fashionable the improvement in the general health of patients has been so remarkable that it is often possible in a sanatorium or health resort to pick out the non-tuberculous visitor by his pale complexion and unhealthy appearance. Like all great inventions, I think the fresh-air treatment of tuberculosis has suffered from excessive enthusiasm, and some of its advocates have gone too far in exposing to bitterly cold weather patients whose metabolism could not respond to such a strong stimulus, either because they had been too much weakened by disease or because they were wrongly constituted for such rigorous treatment.

Much has been written recently about the correlation between the build of the body and the character of the person. It has been found, for example, that the pyknik type, which is thick-set and sturdy, is less liable to introspection than the weedy asthenic type. According to Bacmeister and Lossnitzer,[9] it will be found that these thick-set hearty people will resist tubercle with a powerful growth of fibrous tissue and that this will be favoured by a bracing climate The asthenic type, on the contrary, has difficulty in keeping up his body temperature in a cold climate and his over-active mind also requires more sedative surroundings.

Turning now to a short regional survey, I will begin with the British Isles, the climate of which is essentially maritime, no part of the country being more than 70 miles from the sea; the winters are less cold and the summers not so hot as in inland countries of the same latitude. The rainfall is fairly evenly distributed throughout the year. Winter sunshine is none too plentiful and fogs are common in most industrial centres. The south-east and east coastal regions are slightly colder, drier and more stimulating than the west and Ireland, which provides a more sedative climate. Good sites for the treatment of tuberculosis can be found in almost any county, shelter from strong rain-bearing winds and a dry ground being the most important considerations. Among the most valuable qualities in our climate are the cool summers; the pastures are rarely either snow-covered or parched

by the sun, and this has an important effect on the quality of the meat and dairy produce.

The Scandinavian countries and the Netherlands have a similar summer climate to our own, but their winters are colder. In Central Europe and in all except the northern maritime regions of the United States the summers are so hot that metabolism is unhealthily retarded in the majority of patients.

A Mediterranean type of climate prevails in Southern Europe and in Florida and Calfornia: the winters are mild and sunny and moderately wet; the summers are dry and dusty, and, in spite of the proximity of the sea, warm enough to be too relaxing for most people. The coastal regions of South Africa and Australia are similar. One rather unfortunate feature of the Riviera climate is the sudden drop in temperature which occurs in the late afternoon throughout the winter; the air, being laden with moisture from the sea, produces a peculiarly penetrating cold immediately the sun sets. This sudden chill is so much feared by residents that even in sanatoria all windows are closed from 3 to 6 pm. A few miles inland, at places such as Vence, this fall in temperature is much less marked. Although too sedative for the majority, the Riviera resorts, with which may be classed such places as Majorca, Malaga, Estoril, Madeira, and the Canary Islands, provide a valuable climate for certain frail or elderly patients with little or no tuberculous activity but with damaged, emphysematous lungs liable to bronchitis. The scarcity of well-equipped sanatoria makes these resorts unsuitable even for the rare early cases for whom the climate would be indicated, and better results will be obtained if such cases are treated in good sanatoria in this country until their lesions have ceased to be active.

I have no personal experience of the tropics and therefore only raise the subject in order to dismiss it with a quotation from a paper by Dr. V. S. Hodson,[10] in whose experience " tropical climates are dangerously deleterious to persons suffering from pulmonary tuberculosis."

The most interesting climate in relation to tuberculosis is that of high altitudes; this has the following characteristics: it is cool and dry with low barometric pressure and high intensity of light.

Air temperature falls about 1° F. for every 300 feet ascended; a resort at 6,000 feet will therefore be some 20° cooler than one at the same latitude at sea-level. At Montana, which is at an altitude of 5,000 feet, I have rarely known the shade temperature to be much above 70°, whereas at the bottom of the Rhône valley, only two or three miles away, it would often be between 85° and 90°. In summer the temperature of the higher resorts is frequently lowered by a down-valley wind from snowfields, but in winter the fall in temperature with rise of altitude is only about two-thirds as much as in summer, as the intensity of sunlight, increased by reflection from the snow,

is so much greater than in the valleys. Dorno[11] has found that in January the brilliance of light at Davos is six times as much as at Kiel, whereas in summer the proportions are only 1·8 to 1·0. One result of the intensity of sunlight in the High Alps is the reduction of cooling power. In January, with the thermometer just below freezing point, the cooling power at Basel was 21·2; at Davos with 12 degrees of frost it was only 13·5.

The dryness of Alpine air causes increased evaporation from the lungs, it having been calculated that whereas at sea-level only one-quarter of the water lost by the body comes from the lungs, at 8,000 feet evaporation from lungs and skin is approximately equal.

Not only is the total amount of sunlight greater at a high altitude, but the proportion of ultra-violet rays is considerably greater, these short rays being very easily absorbed by the lower and denser layers of the atmosphere. Pigmentation and erythema are notoriously easily produced even in the middle of winter, and tuberculous patients need to be warned against the danger of too much sunlight. I think the most useful effect of the Alpine sun is to enable people to tolerate with comfort and pleasure a cooling power which would be quite intolerable at a lower altitude.

The low barometric pressure is also a great stimulus to metabolism; more air has to be breathed, particularly during muscular exercise; this increased ventilation of the lungs is carried out by deeper rather than by more frequent breaths. At 5,000 feet the barometric pressure is only 83 per cent. of that at sea-level and the water vapour pressure only 60 per cent. To counteract the shortage of oxygen in the air the red corpuscles increase in number. Contraction of the spleen is the first mechanism called into play, and this is followed by increased activity of the bone marrow, reticulocytes being about three times as numerous in the High Andes as at sea-level. The degree to which a healthy body can become acclimatised to high altitudes is extraordinary. During the civil wars following the Spanish conquest of South America a battle was fought at the height of the summit of the highest Alps, that is to say at an altitude at which even the trained climber advances step by step with laboured breathing. A prodigious effort must have been required to strike a hard enough blow to get through the heavy armour of the period.

Even at 5,000 feet the basal metabolic rate is increased about 20 per cent.[13]

The resting pulse-rate is unaffected in normal people at the height of the Alpine health resorts, but until acclimatisation has occurred, marked acceleration takes place on exertion. I used to find, when living at Montana, that even after an absence of a month I could not fully enjoy a single at tennis for about a fortnight. Huggard[15] observed that patients with mitral incompetence generally complained of discomfort at Davos, but aortics

rarely suffered inconvenience. Cheyne-Stokes breathing was often observed with trivial ailments.

The effect of altitude on the nervous system is of great importance. In general, highly nervous people do not stand altitude well; it is not uncommon to find otherwise healthy people with a nervously irritable heart, causing tachycardia or simply an occasional extra-systole, who suffer such discomfort even at a moderate altitude that they have to be sent to a lower level. Insomnia is another frequent complaint, and I have calculated that at 5,000 feet sanatorium patients require sleeping draughts two or three times as frequently as at sea-level. I am not one of those who look on the barbiturates, properly used, as dangerous poisons, and merely quote this observation as an illustration of the stimulating effect of altitude on the nervous system.

One of the most interesting studies of the effect of high altitude has been carried out by Barcroft[14] in the Andes at 14,300 feet; in describing the mental symptoms he writes: " Alcohol affects different persons in different ways, so in my journeyings in high altitudes I have seen most of the symptoms of alcohol reproduced. I have seen men vomit, I have seem them quarrel, I have seen them become reckless, I have seen them become garrulous, I have seen them become morose . . . I have seen the most loyal companion become ill-tempered and abusive." That the cause of mountain sickness is largely mental was recognised by Charles Darwin,[16] who noted that while crossing the Andes his nausea was instantly cured by the discovery of fossils; unfortunately this antidote does not excite sufficient interest in most of us to be effective. The mental effects of altitude were mentioned by the pioneer Alpine climber de Saussure,[17] who noted that when camping at 11,000 feet his party " were more liable to impatience and outbursts of anger." I have collected similar evidence from the highlands of South and equatorial Africa, where the strain of living for a long time at a high altitude is felt by an appreciable proportion of the population. Whereas in the extreme heights of the Andes and Himalayas every traveller suffers from the altitude (even the natives are cyanosed and have clubbed fingers), at the more moderate elevations of the Alps and South Africa it is only the minority who suffer any obvious effects, and these often do not appear unless residence is prolonged for more than six months. Children, as a rule, stand altitude well, and surgical forms of tuberculosis do particularly well in the Alps, as they can sunbathe throughout the year.

When considering the type of tuberculous patient to be sent to high altitudes for treatment, the nervous system comes first in importance; a highly excitable temperament or tachycardia often indicates that a very stimulating climate will not be well tolerated. There are certain exceptions

to this rule: in some cases the greater distance of the Alpine resorts means that the patient rests better through being far away from his worries and fussy relatives. As an example of this type of case: a girl's nervousness was aggravated by an over-solicitous mother; as the latter suffered from mitral stenosis the daughter was advised to go to Switzerland, where her mother could not follow her. As regards the lungs, Barcroft[18] has called attention to the fact that deficiency in ventilation caused by old fibrosis may be calamitous at high altitudes—the possessor of such a lung would suffer from mountain sickness at a much lower altitude, although at sea-level the blood would be sufficiently aerated. Clinical experience at an altitude of 5,000 feet confirms this observation; patients whose vital capacity has been much reduced by active disease or by pulmonary fibrosis are difficult to acclimatise. Although by insisting on two or three weeks of strict rest as a preliminary a considerable number of these patients succeed in adapting themselves to the altitude, there remains an appreciable number who fail to do so and who continue to be so short of breath on slight exertion that it is best to send them down without further delay to a lower altitude.

Pneumothorax patients, when going to the Alps, should travel when a refill is due, as with rise in altitude the air in the pleural space expands and severe dyspnœa may result, especially in patients with a mobile mediastinum.

An interesting mass experiment was carried out by Phillips[19] in America: all the patients in his sanatorium, except the hyperthyroids and those unable to hold the breath for twelve or preferably fifteen seconds after expiration, were removed at the end of May from the main sanatorium of altitude 1,000 feet to one at 5,300 feet. On making the change the patients felt stimulated to the point of wakefulness at night, the appetite was increased, there was dyspnœa on exertion, and for the first ten days no exercise was considered advisable. Most consumptives were benefited by the change, but it would not be justifiable to conclude from this that they would be in this country, as the valley sanatorium in question was excessively hot in summer, temperatures of 100° F. occurring in May, and even at over 5,000 feet the average summer temperature was 69° F.

I am afraid I have not been able to produce any statistics of value regarding my own experience on the comparative merits of sanatorium treatment in England and Switzerland. In the first place the patients had already undergone selection, and in the second, in the great majority of cases, the period of altitude treatment was merely a phase lasting a few months to a year or more, but preceded or followed by treatment in this country. I must therefore be content with passing on some clinical impressions. Speaking generally, in the majority of cases I think it makes

very little difference whether the patient is treated in Great Britain or in the Alps provided that he goes to a good sanatorium where discipline is strict. I must insist very strongly on this point, because I have known many cases in which the patient has relied on the Swiss air to cure him and has not carried out rest treatment strictly enough. Such an attitude often leads to disaster. I think that unless there is some special reason for treatment being carried out at a distance, early cases, especially when there are active symptoms, are best treated at a low or moderate altitude where their metabolism will not be excessively stimulated. After an initial period of rest, if sanatorium treatment has to be prolonged, a change to a higher altitude will be an advantage in a considerable proportion of cases. This need not necessarily be in winter, as the cool, bracing summer climate of the Alps is equally healthy.

Summary.

Climate appears to have considerably less influence on tuberculosis mortality than such factors as racial immunity and social conditions; there is none the less some evidence that warm, damp climates are associated with a relatively high tuberculosis mortality.

Climatic stimulation has a definite place in the treatment of tuberculosis, but care must be taken not to expose to a highly stimulating climate patients whose powers of response are inadequate. In the selection of cases careful individualisation is necessary; dyspnœa from diminished vital capacity, cardiac arhythmia and nervous instability all tend to be increased with rise in altitude.

No air in the world can make up for the absence of medical guidance and discipline which a well-conducted sanatorium provides.

With some exceptions, cases with symptoms of activity are best treated in the first place at a low or moderate altitude; selected cases with adequate powers of response should subsequently be sent to higher altitudes.

More sedative climates of the Mediterranean type are suitable for patients with bronchitis and emphysema but little or no tuberculous activity.

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"TOMOGRAPHY"

REPORT ON A METHOD OF X-RAYING SECTIONS OF THE BODY

By J. W. CRAIG,
M.A., M.D.,
Temple Cross Research Fellow in Tuberculosis.

During a recent visit in Berlin my attention was drawn to a new method of radiography, which is especially useful when dealing with pathological lesions in the chest.

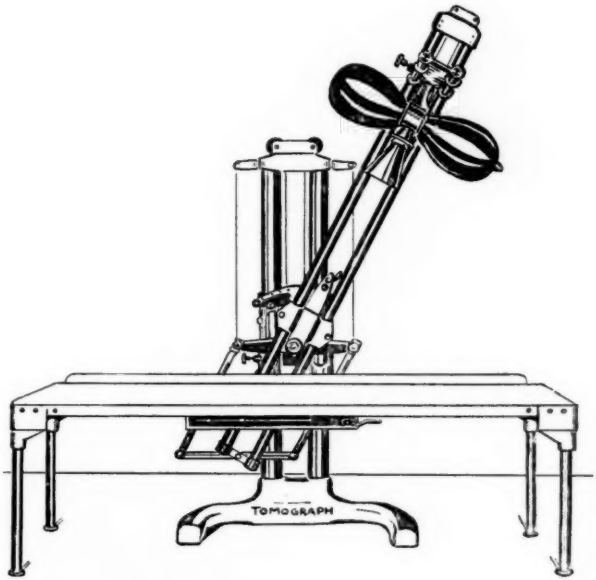
The essence of this method, called "Tomography," consists in the ability to represent in the X-ray picture sections and layers of any thickness and isolated at any depth in the body—in other words to eliminate parts located in front or behind the sections pictured, thus avoiding the superimposition and summation of shadows which may lead to erroneous pictures.

The problem of picturing sections was first appreciated by Bocage in 1921. He suggested the fundamental idea of a co-ordinated movement of the X-ray tube and carrier of the film plate around the object during the taking of a picture.

This makes it possible to have X-ray shadows of all points of a plane fall during the whole period of movement on the same spot of the photographic film. This plane alone is shown sharply in the picture, while all the points lying above or below this are projected to constantly changing places and are therefore blurred.

This was only of theoretical value until Professor Chaoul and Dr. Grossmann of the Charité Hospital, Berlin, designed a "Tomograph" for practical use. This apparatus makes it possible to take pictures of the body layers in a thickness from a few millimetres to 2 centimetres.

The Tomograph, designed by Professor Chaoul and constructed by the "Sanitas" Company, Berlin, consists of a double-armed pendulum revolving around the horizontal axle. On the top of the pendulum the tube focus is attached, on the bottom the film carrier. When the pendulum is allowed to swing from one position through the vertical centre position into its other ter-



minal position, the body layer lying at the height of the axis of the revolution will be shown as a clear picture, while all other formations above and below it will be blurred. One therefore only requires either to raise or lower the axis of the revolution—in other words, raise or lower the whole pendulum device—in order to obtain pictures of higher or lower layers. The time required for taking pictures varies from several seconds to one second.

The X-ray picture reproduced on page 154 was supplied to me by the "Sanitas" Electro Medical Company, Friedrichstrasse 131, Berlin N 24. They were also kind enough to arrange for a special working demonstration of the Tomograph, of which they are now the makers and distributors.

In the picture the Tomograph demonstrates clearly a large cavity which was not shown by ordinary X-ray.

As Professor Chaoul* has remarked, it would be premature to limit at this time the field of the use of Tomography, since the method is compara-

LATERAL VIEW. A CAVITY IN UPPER ZONE WHICH WAS NOT VISIBLE BY ORDINARY X-RAY IS SHOWN BY THE TOMOGRAPH.

tively new. When one has seen a number of these pictures one understands how useful this method may become in demonstrating obscure pathological changes in the lungs, bronchi, and bloodvessels.

* Professor H. Chaoul: *Deutsche Medizinische Wochenschrift*, 1935, No. 18.

THE RELIEF OF LARYNGEAL PAIN

By L. B. STOTT,
M.B.,
Resident Medical Officer, Papworth Village Settlement.

The practice of blocking the internal branch of the superior laryngeal nerve, introduced by Hoffman in 1908, still retains its popularity as a method of giving relief in dysphagia. It does not, however, relieve the agonising pain that shoots from the pharynx to the ear during the act of swallowing.

This pain is described by nearly all patients with a tuberculous lesion in the larynx, and the attitude of the victim who places his forefinger over the temporal artery and his thumb under the angle of the jaw while he regards a bowl of cold gruel is familiar to every tuberculous worker.

The constancy of the site of this pain is possibly not without its significance.

It is a noteworthy fact that visibly enlarged glands are not commonly an accompaniment of tuberculous disease in the larynx, though it has been recorded by Emerich Karafiath that 30·5 per cent. of patients suffering from laryngeal tuberculosis have a palpably enlarged prelaryngeal gland (gland of Poirier).*

The lymphatics from the upper part of the larynx are received by the sub-sterno-mastoid glands, and the largest of this group lies in the digastric triangle, or just under cover of the posterior belly of the digastric muscle.

It is not without reason to suppose that the upward movement of the hyoid bone on deglutition is accompanied by severe pain by reason of the contraction of the digastric and mylohyoid muscles on the slightly swollen gland. The normal consummation of the reflex of swallowing is prevented and the obstructed action of the stylohyoid muscle is apparently responsible for the characteristic shooting pain in the ear.

Six cranial nerves are concerned in the movement of the larynx on swallowing. The laryngeal mucosa is supplied by the internal branch of the superior laryngeal nerve, which is derived from the pneumogastric or tenth cranial nerve.

The spinal accessory, or the eleventh, supplies:

(*a*) laryngeal muscles;

(*b*) sterno-mastoid and upper third of the trapezius muscles.

* "A Magyar Orvosok Tuberkulozis-Egyesuletenek Munkulatai." Budapest (Junius 8-9, 1933).

The hypoglossal, or twelfth, supplies motor branches for the muscles situated above the hyoid bone and taking part in the control of the movement of the tongue.

The anterior belly of the digastric and the mylohyoid are supplied by the mylohyoid branch of the inferior dental nerve, which is derived from the fifth cranial nerve. The posterior belly of the digastric and the stylohyoid is supplied from the seventh or facial nerve.

The sensory fibres for the upper regions of the pharynx and the motor nerves for the contractor muscles of the pharynx are supplied by the ninth, or glossopharyngeal, nerve.

That is to say, six nerves—the fifth, seventh, ninth, tenth, eleventh, and twelfth—all take their part in the act of swallowing, and therefore it is a matter for little surprise that the blocking of one branch of the tenth fails to relieve pain during swallowing, though it does anæsthetise satisfactorily the laryngeal mucosa.

The mylohyoid nerve, however, is accessible at its point of division from the inferior dental nerve, as it enters the mandibular foramen behind the projection of the lingula.

The terminal branch of the facial nerve to the inferior edge of the posterior belly of the digastric muscle is also of easy access, as the anatomical relations of the digastric muscles and its attachments to the hyoid bone have definite surface markings. Thus it is possible to block the branches of three cranial nerves to the parts concerned, leaving the ninth, eleventh, and twelfth unaffected.

That is to say, by infiltrating the neighbourhood of the posterior belly of the digastric muscle with local anæsthetic and at the same time blocking the mylohyoid nerve and the internal branch of the superior laryngeal nerve on both sides, it is possible to render the act of deglutition painless without interfering with mastication or the movement of swallowing, even though occasional unavoidable blocking of the inferior dental nerve produces anæsthesia of the lower lip.

At the present time, when the practice of injection of lipiodol by the crico-thyroid route is becoming general, it is perhaps superfluous to describe the surface anatomy of the neck, which is abundant in well-known landmarks.

The most prominent feature in the front of the neck is the upper border of the thyroid cartilage, which is at about midway between the point of the chin and the top of the sternum.

If the neck is extended several other structures come into view. The hyoid bone can be seen curving backwards until it disappears under the sterno-mastoid muscle on each side.

The greater cornu can be felt by passing one's finger along the bone and pushing the sterno-mastoid aside.

Quite frequently the anterior belly of the digastric muscle can be seen descending towards the point on the hyoid bone where, through its median tendon, it alters its course before enlarging into the posterior belly.

The injection of the internal branch of the superior laryngeal nerve is best undertaken with the patient sitting up with the chin extended.

Inspection, followed by gentle palpation, suffice to place the operator in possession of the anatomical relations. Having located the mid-point between the superior cornu of the thyroid cartilage and the greater cornu of the hyoid bone, an intradermic weal is made just anterior to it with local anæsthetic.

The hand which does not hold the syringe is now used to protect the vessels in the carotid sheath and the needle is passed into the thyrohyoid space.

As the needle penetrates the larynx and a drop or so of anæsthetic descends the trachea the patient will cough and then swallow, moving the needle, which should be withdrawn slightly before infiltration of the tissues surrounding the nerve. About ½ c.c. of anæsthetic is enough to produce anæsthesia.

By partial withdrawal of the needle and depression of the barrel of the syringe a few drops of anæsthetic can be deposited near the lower edge of the posterior belly of the digastric muscle without making a fresh skin puncture.

In order that the mylohyoid nerve may be reached, the patient sits in exactly the same position, except that instead of extending the chin he opens the mouth.

If the operator now places the tip of his forefinger on the gum immediately behind the last molar tooth in the lower jaw (or behind the position where the last molar tooth ought to stand, as the case may be) he will note that he is palpating the concave floor of a triangular space.

The base of this space is formed by the posterior margin of the tooth socket and the apex of the triangle by the approximation of two bony ridges which pass backwards to the ramus of the lower jaw (the internal and external oblique lines).

If a blunt probe is now passed backwards over the centre of the finger-nail of the palpating finger it will be found that a depression can be made in the mucous membrane over the division between the internal lateral ligament and the pterygoid muscle.

This is the point of insertion of the needle, but before making the actual injection it is well to have satisfied oneself by inspection and gentle palpation of the cheek as to the degree of flair or divergence of the ramus, and also

to dry with a small piece of cotton wool the site of injection. As a very great refinement some such preparation as anethsone also can be applied before puncture of the mucous membrane. The mucous membrane in the mouth becomes less sensitive as one proceeds backwards, and injection at this site is practically painless.

Insertion of the needle is accomplished by the sort of action which is sometimes described as *tour de maître*—that is to say, the barrel of the syringe is held firstly over the bicuspid teeth of the opposite side until the internal oblique line is reached, secondly parallel with and above the molar teeth on the same side until the needle attains the level of the lingula, and finally over the central incisors for the actual injection. On beginning the second stage it is well to remove the forefinger from the post-molar triangle, as this action releases the mucous membrane, which carries the point of the needle with it clear of the internal oblique line. One important point to remember is that the temptation is to direct the needle too low down so that the anæsthetic is deposited on the inner surface of the ramus over the inferior dental canal too far from the point of division of the mylohyoid nerve. A very little practice, however, is sufficient to ensure almost 100 per cent. success to the manœuvre.

This refinement of the laryngeal block commits one to two injections:

1. (*a*) The usual injection at the position where the internal laryngeal nerve pierces the thyrohyoid membrane.

(*b*) The infiltration of the neighbourhood of the posterior belly of the digastric muscle from the point where it joins the anterior belly at the pulley-like attachment of the hyoid bone.

Both these can be done through the same skin puncture.

2. The injection of the mylohyoid nerve according to the technique used in dental surgery for the inferior dental nerve, but at a suitable lower level.

These two injections can be undertaken on both sides if required.

The choice of an anæsthetic is a matter of individual preference. The preparation usually recommended is a solution of procaine in 65 to 85 per cent. alcohol with a little chloroform and distilled water. Waites' No. 4 formula (2 per cent. procaine) gives excellent results, and a Dental Manufacturing Co. No. 4 carbon steel cartridge needle can be used for all injections.

It is rarely necessary to repeat the injection more than once a week.

Summary.

(1) Blocking the internal branch of the superior laryngeal nerve anæsthetises the laryngeal mucosa but does not relieve pain on swallowing.

(2) Obstructed muscular contraction causes acute pain.

(3) The lymphatics of the larynx drain into a gland which, when swollen, obstructs the action of the muscles of deglutition.

(4) The mylohyoid nerve supplying the anterior belly of the digastric muscle and the mylohyoid muscle can be blocked by simple injection.

(5) The mylohyoid is a motor nerve, but no hesitation need be felt in blocking it, as the manœuvre indicated leaves the glosso-pharyngeal, the spinal accessory and the hypoglossal nerves unaffected, and is without risk of paralysis.

CLINICAL CASES

A CASE ILLUSTRATING THE DISAPPEARANCE OF SUCCESSIVE THICK-WALLED CAVITIES IN THE LUNG WITHOUT THE APPLICATION OF ANY FORM OF COLLAPSE TREATMENT

By DENNISON PICKERING,
M.D.,
Medical Superintendent, Pendyffryn Hall Sanatorium.

In the treatment of pulmonary tuberculosis it is not, perhaps, very uncommon to see cavities disappear under treatment without any form of collapse. The case described here, however, is striking in that a cavity of considerable size, with obviously thickened walls, disappeared entirely in a comparatively short time. Not only this, but later, during a recrudescence of activity, two fresh cavities appeared; these increased slowly in size for nearly six months and then gradually disappeared during the ensuing six months.

The patient was a girl of 23, living at home in comfortable circumstances, who was admitted to this sanatorium in April, 1932. The family history was good. The patient had felt well until May, 1931, when she developed a dry cough, was easily tired, and began to lose weight. She became gradually worse, sputum developed, and in September her breathing was "wheezy." In October she had pleurisy on the left side, and was kept in bed for a fortnight. The cough became steadily worse and the sputum profuse. The patient went for a holiday without deriving any benefit. Just before Christmas she was examined, and was told that there was nothing wrong except bronchitis. The lassitude and cough continued to get worse, and on several occasions there were severe night sweats. Eventually the patient asked for another opinion. As the result of X-ray examination in April, 1932, pulmonary tuberculosis was diagnosed and sanatorium treatment advised. The notes on admission were as follows:

Condition on Admission.

Symptoms.—Cough, with sputum; lassitude; poor appetite; sleeping badly; night sweats.

Examination.—General condition poor. Weight 6 stone 8 pounds 2 ounces in dressing-gown (highest known weight 7 stone 12 pounds in bathing-dress). Temperature 98° to 99·6°. Nothing abnormal in alimentary or nervous systems. Urine normal. Heart apparently normal. Pulse 80 to 96. B.P. 98/62. Sputum purulent; swarming with tubercle bacilli.

Lungs.—Right: Resonance slightly impaired. Voice sounds increased over upper part, pectoriloquy at apex. Breath sounds harsh. Medium râles down to third space in front and at apex behind.

Left: Impaired resonance more marked. Slight pectoriloquy at apex, and increased voice sounds over upper part. Breath sound bronchial below outer part of clavicle, harsh elsewhere. Medium râles down to third space in front, and within vertebral border of scapula posteriorly.

X-Ray Examination.—The diaphragm moved evenly and well. Costophrenic angles clear. Right apex and upper part of left lung did not light up well on inspiration.

Film.—Right: Mottled opacities in upper third, most dense towards the apex.

Left: More marked, irregular mottling involving upper two-thirds. Medium-sized, thick-walled cavity in middle zone, with one or two small, rather suspicious, clear areas higher up.

Progress under Treatment.

The patient was kept resting in bed under observation. Although there was a fair amount of disease on the right side, a left artificial pneumothorax was naturally considered. As, however, the patient and her parents were much opposed to it and progress from the beginning was very satisfactory, the question was postponed. The temperature soon settled to an evening maximum of under 99° with a premenstrual rise to just over 99°. All the symptoms improved considerably, and the weight increased. The pulse, however, remained rapid, varying from 84 to 100.

After a month the patient was allowed to sit up in her room, and soon afterwards to spend the afternoon lying in a châlet in the grounds.

After a short while the lassitude increased again, the appetite fell off, and the patient lost a couple of pounds in weight. We found that she was not resting as much as was supposed, so after a few days in bed she was allowed out on a balcony instead of in the grounds. Progress was then more satisfactory again.

At the beginning of June the patient said that she had coughed a little blood into her throat during the night, but had swallowed it. She said she felt some gurgling in her chest afterwards. The temperature and general condition were entirely unaffected, and the weight continued to increase.

By the middle of June the latter was up to 7 stone 2¼ pounds, and the temperature was running an almost normal course, rising to a little over 99° during the premenstrual phase. The sputum now contained only a few tubercle bacilli per field. X-ray examination, however, showed that the main cavity was larger with at least two accessory loculations, although the opacities in the upper third on the left appeared somewhat harder in outline. An artificial pneumothorax was again advised, and this time the advice was accepted; however, no free pleural space was discovered.

Routine treatment was continued. The general condition remained about the same, but the physical signs showed gradual improvement, the râles being less coarse and covering a decidedly smaller area on both sides. X-ray examination in July, however, showed a very definite extension of infiltration below the cavity. A course of sanocrysin was therefore advised and carried out during the ensuing months. This resulted in marked improvement. The weight, which had only increased ½ pound between June 27 and August 1, began to increase at once, the appetite improved, and the patient felt decidedly better. The sputum diminished until there were only occasional specimens, in some of which no tubercle bacilli could be found. The physical signs in the chest also improved. The most striking change, however, was in the X-ray appearances. In October the large cavity was less obvious, the walls being vague and irregular and the space smaller. There was no sign of any smaller cavity higher up. In December the cavity was no longer visible, only some vague, rather dense opacities and apparently calcified spots marking where the walls had been.

Some weeks after the sanocrysin had been stopped a troublesome rash of eczematous type had appeared about the inguinal region and the adjacent parts, and also on the scalp and right arm. This proved very resistant to treatment. In addition to local applications "Thiostab" was given, but without apparent benefit. This rash lasted for three to four months, and then slowly improved, but did not entirely clear up until almost a year later.

In the meantime the patient returned home against advice. On X-ray examination the right side then appeared approximately normal and the left side showed considerable clearing. The remaining opacities were firmer in outline, and only a few small calcified spots could be seen in the cavity area. The weight was then 7 stone 3¼ pounds. There was no cough or sputum. The breath sounds were still harsh, but there was no bronchial breathing. There was a group of fine râles around the left clavicle and some coarse ones, surrounded by finer ones, over the upper half of the left side posteriorly. The blood pressure was 110/82.

Seen again in June, 1933, there was a history of recent phlyctenular

conjunctivitis, followed by a cold in the head, with temperature up to 100° for several days. Then a recurrence of lassitude, general malaise, and cough with sputum. The weight had fallen by 5¼ pounds. The area of râles on the left side in front was larger, but posteriorly the râles were rather less coarse. Tubercle bacilli were again present in the sputum. X-ray examination showed more infiltration on the left side, especially in the middle zone, with two small cavities with thickened walls in the outer part of the upper third. As the rash, though much better, had not cleared up, only routine treatment could be given. The symptoms, physical signs and general condition improved satisfactorily. The cough and sputum cleared up, and eventually no tubercle bacilli were found in such specimens of sputum as were obtainable. The râles were reduced to small groups around the left clavicle and along the vertebral border of the scapula. The cavities, however, increased in size. Early in 1934 the patient did not feel so well. The physical signs were still about the same, and X-ray examination showed no increase of infiltration, but the cavities were slowly becoming larger. In April, after careful consideration, it was decided to give a further course of gold. The eczema had finally cleared up about six months previously. Moreover, the patient had remembered that as a child she had been subject to an irritable rash if she ate acid fruit, and the final clearance of the rash this time had coincided with the avoidance of such fruit, of which she had been eating a lot. Solganol " B " oleosum was used on this occasion instead of sanocrysin, and the course was started with very minute doses, working up gradually to 0·2 gramme. After a few of these doses had been given there was a mild stomatitis and some irritation at the site of the old rash, so the gold was discontinued. The stomatitis and rash cleared up rapidly. Once again the patient very soon showed improvement, and she kept well during the summer. The temperature was normal, except for very slight rises during the premenstrual period, and the pulse rate was now 76 to 84. Again the X-ray appearances were striking. The cavities had reached their maximum size in June. By the end of the year they had disappeared, only a few calcified spots remaining where the walls had been. Since then the patient has spent a great deal of time in this neighbourhood. Her health has remained satisfactory in every way. The physical signs have remained the same. X-ray examination shows a number of small dense opacities scattered throughout the upper two-thirds on the left. It has been difficult to get specimens of sputum for examination, but all the results have been negative. She now leads a normal life. The disease appears to be thoroughly arrested and there seems to be quite a good chance of a satisfactory permanent result.

THE TUBERCULIN TREATMENT OF PULMONARY TUBERCULOSIS BY THE PERCUTANEOUS EXHIBITION OF TUBERCULIN (PHILIP'S METHOD)

By J. H. BLACKBURN,
L.R.C.S., L.R.C.P.(ED.), L.R.F.P.S.(GLAS.),
Medical Superintendent, Westwood Sanatorium, Westwood, Queensland.

The routine method known to most workers in pulmonary tuberculosis is the injection one (subcutaneous route), and I have adopted for the last few years the percutaneous one which was first suggested by Sir Robert Philip, Professor of Tuberculosis at the University of Edinburgh, who claims to be able to detuberculise his tuberculous patients in this way and effectively prevent the extension of the disease, and in my experience such is the case.

Moro has pointed out that a local skin reaction follows the inunction of tuberculin incorporated with a suitable base, and suggested that this reaction might be used for diagnostic purposes.

Advantages.

1. It does not appear to the patient as an operation.
2. It produces a certain amount of reaction which can be used as an index and the dose thus regulated.
3. It certainly does not interfere with the patient in any way.
4. The treatment can be performed either by the nurse or other responsible person should it be advisable.
5. As it is already prepared for immediate use, it obviates all the necessary apparatus required for preparation and dilution.

Preparations.

The "Commonwealth" Tuberculin Ointments are obtainable only from the Director, Commonwealth Serum Laboratories, Royal Park, Melbourne, Victoria, in the following two strengths and composition, the quantities being in 1-ounce and ½-ounce pots.

No. 1 (Strength 10 per Cent.).

Old tuberculin (0·5 per cent. phenol added) ..	10 per cent.
Fatty bases	85 „
Eucalyptol	5 „

No. 2 (Strength 25 per Cent.).

Old tuberculin (0·5 per cent. phenol added) ..	25 per cent.
Fatty bases	70 „
Eucalyptol	5 „

Note.—These are prepared in batches and numbered as obtains on all biological products from the Commonwealth Serum Laboratories.

Modes of Administration.

1. Each patient is thoroughly examined prior to beginning treatment, which includes charts and sputum examination.

2. I always begin with the 10 per cent. ointment as a routine, and each patient receives at least from twenty-four to thirty-six applications of that strength, and all being well passes on to the 25 per cent. series and receives many dozen applications, until examination proves that same can be dispensed with. If need be it is reapplied.

3. Each application is done weekly and a different area of the back being selected for each operation, the area being one to two square inches. The time taken is about twenty minutes.

4. Should there be a sudden rise in temperature accompanied with malaise, etc., it is advisable to postpone treatment for a week or a fortnight.

Results.

To date 72 patients have received the percutaneous method of tuberculin, of which 53 have been arrested and 19 improved (the last figure includes 2 asthmatics, and also 10 patients who left the sanatorium before completing treatment). It is well known that some asthmatics respond to tuberculin (protein shock therapy).

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CONSULTATION

CASE

By GEOFFREY TODD,
M.R.C.P.
Medical Superintendent, King Edward VII. Sanatorium, Midhurst.

The case I am about to describe was first admitted to a sanatorium in September, 1933. He gave the following history:

"Had had a hæmoptysis of about half a pint in July, 1933. On July 30 left artificial pneumothorax was commenced, and he was removed to the sanatorium on September 1."

On admission he was dyspnœic, thin, pale, and had a temperature of 99·2°. Weight was 9 stone. He was confined to bed.

X-ray showed trachea and mediastinum displaced to the right. The left lung had irregular collapse in all zones. Right lung was normal.

The patient was kept in bed for three weeks, by which time, by screen control and carefully regulated refills, his temperature had become normal and his general condition had improved greatly. Dyspnœa, even on movement of an ordinary nature, was now absent. He was then slowly advanced by the usual sanatorium routine, and had no setbacks.

He was discharged on March 17, 1934, in good condition, to go home and have refills from his London specialist; and he intended to resume work on June 1, 1934.

All went well until September of that year, when he noticed that his cough, which had entirely disappeared, was returning, and he once again had a little sputum. This was examined and found positive. X-ray showed that his lung had re-expanded slightly, so his refills were given at shorter intervals. As he still had cough and sputum despite this, he was readmitted to the sanatorium on October 9, 1934.

On examination he looked well, except that he was a little thinner than on discharge. He had no dyspnœa, but he was staining in his sputum at frequent intervals during the day. Temperature was normal. Sputum was negative. He was kept in bed.

On October 12 he complained of a sudden sharp pain in his left side; he became dyspnœic, and then had a hæmoptysis of 3 ounces. Temperature rose to 101°. On examination the left side of the chest was immobile, and there was complete absence of breath sounds. There was also a coin sound present. The heart and mediastinum were displaced about 2 inches to the right. A pneumothorax needle was inserted, but there was a pressure of only −5 0. On putting in 100 c.c. of air his dyspnœa increased and his heart moved a further ½ inch to the right. This seemed to prove that he had a very mobile mediastinum, and this was concluded to be the cause of his dyspnœa. We were now confronted with a problem, because, should he have a further hæmoptysis, we would have great difficulty in collapsing his lung further, owing to this mediastinal swing. It was decided to give him small refills of not more than 200 c.c. at weekly intervals.

His temperature remained high for fourteen days and then fell to normal by lysis in the succeeding four days.

He was able to get up to tea on November 10.

On December 8, following a refill, his temperature once again commenced to rise, and reached its peak of 102° at the end of nine days. It remained constant at this level for twenty-one days. During this period a coin sound once more appeared, followed by the formation of fluid. As soon as an appreciable amount was present, a sample was removed for pathological examination. The report was: " Culture sterile: no tubercle bacilli present; and only a few neutrophiles are seen." By January 15, 1935, the fluid had reached the level of the second rib in front, and, as his heart was considerably displaced, gas replacement had to be done. (We have always made it a rule that, if a pleural fluid is sterile, we do not remove it during the acute febrile stage, unless it is causing decided embarrassment to respiration and the heart.) Two pints of fluid were removed, and the final pressures were left at −6 −1. His temperature fell to 99° four days after this, but remained at that level.

On February 1 gas replacement was again performed, owing to a great increase in the fluid. Twenty-six ounces were removed; and the end pressure was left at −6 0. This specimen of fluid also proved sterile.

The patient's temperature refused to fall below 99°, although by now his general condition was once more much improved.

Gas replacement was performed a third time on February 20, when 24 ounces of fluid were withdrawn. The pathological report on this was: " Tubercle bacilli present: no other organisms." The fluid was now becoming thicker and slightly turbid.

A further gas replacement was done on March 23, when 32 ounces were removed, also containing tubercle bacilli.

As the fluid was showing no signs of drying up, and as it contained tubercle bacilli, it was decided to give the patient a course of weekly pleural irrigations, commencing with normal saline for the first one, to see if any untoward reaction took place. All went well, so eusol was used after the first week. These washouts were continued for six weeks, and by this time, despite the irrigation, the flakes of fibrin had become so thick and tenacious that it was impossible through ordinary aspiration needles to remove the pus.

It was decided to leave him alone for a couple of months, to watch events carefully, both clinically and radiologically. The patient's general condition was quite good now: he was up half a day. Temperature, however, remained at 99° every evening.

By July 24 the fluid had so much increased that it was necessary once again to remove it. Twenty-five ounces of turbulent green pus were removed, and this was found T.B. positive.

To add to our difficulties a small sinus now developed in the needle track, although all precautions, such as the patient lying on the opposite side for twenty four hours and our running iodine down the needle track, had been carried out.

At the beginning of September, as the fluid was still reforming and the sinus discharging slightly, it was decided to resume carrying out weekly pleural lavage with eusol. This was done regularly, and as high a negative pressure as possible was left at the end of each washout.

We were now determined that a complete thoracoplasty would have to be done on the left side; and, in order to facilitate this, we were endeavouring to bring the lung out as much as possible and thus diminish the size of the intrapleural cavity.

Left phrenic evulsion was done on September 21.

The washouts were continued weekly.

On October 5 left upper stage thoracoplasty was performed under gas and oxygen, when 21 inches of ribs 1 to 5 inclusive were removed.

For two days following this the patient had a brisk reaction, but then settled down and became fairly comfortable.

An axillary stage was carried out on October 19, when 11 inches of ribs 2 to 5 were removed, well round to their anterior ends.

On November 2 a lower stage was done, when 36 inches of ribs 11 to 6 inclusive were removed.

The patient had a sharp reaction following this last stage, but settled down after three days, and made a slow recovery.

On November 13 pleural irrigation was recommenced, in order to keep dry the residual small pleural cavity, and, by leaving large negative pressures at the end of each washout, it was hoped that the lung would now expand

the small distance necessary to obliterate the cavity. The fluid was examined after each weekly lavage, and was found to be always sterile and to contain no tubercle bacilli following the thoracoplasty.

An average of 6 ounces of pus weekly was removed after completion of the operation.

The fluid gradually became less and much clearer and thinner until May 6, 1936, when only 2 ounces of clear fluid were removed and a negative pressure of −22 −8 was left.

Screening at weekly intervals following the above date until now has shown the cavity to be completely obliterated, and the lung appears to be adherent to the chest wall.

The patient has now been able to walk six miles daily with a normal temperature, and has gained considerable weight. He has no cough or sputum, and his right lung has remained normal throughout. He has returned home, and hopes to resume work in the autumn.

The points which arose for consideration during the case were:

(1) How to keep adequate collapse in a case of mobile mediastinum. The giving of small frequent refills seemed to be the best solution of this problem.

(2) When to remove a pleural effusion which had proved sterile on culture. I consider that this should never be done during the febrile stage, unless dyspnœa is present in large degree.

(3) Whether, when tubercle bacilli are found in the fluid and the fluid fails to dry up or show signs of decreasing within one month, pleural irrigation should be commenced. I consider that it should, and that it should be continued until the fluid becomes thin, if possible, and sterile.

(4) What further treatment is to be carried out when washouts fail to dry up the pleural cavity completely. In cases such as this complete thoracoplasty must be performed.

(5) The continuance of washouts after completed thoracoplasty. Washouts should be carried on until the cavity has obliterated and no more fluid is present.

In conclusion, it is important to mention that all fluid must be removed from the pleural cavity the day before each stage of operation. If this is not done there is a great risk of rupturing the underlying lung by pressure and the consequent drowning of the patient by the inrush of pleural fluid.

THE EAST LANCS. TUBERCULOSIS COLONY, BARROWMORE HALL

MEDICAL DIRECTOR'S REPORT FOR THE YEARS 1933, 1934 & 1935

We have received the report of the Medical Director, Dr. E. L. Sandiland, on the above Institution.

This settlement is run on the lines of Papworth and Preston Hall Settlements, and has been in existence fifteen years. It comprises a Sanatorium, an Industries Section, and a Settlement.

The Settlement has been gradually extended as new settlers have been absorbed by the Industries Department, and now contains twenty-five cottages and a Hostel for single men.

Fifty-seven men have been settled since the first cottages were completed in 1924, 10 have left the Settlement, and 11 have died.

There are now 36 settlers—20 married and living with their wives and families in cottages and 16 single men living in the Hostel. The total population of settlers (and dependants) living on wages earned in the Industries is 91.

Statistics are given showing that the hours of work lost from sickness due to tuberculosis amount to 6·1 per cent. and from other disease amount to 3·4 per cent.

The fact that there have been 11 deaths among the settlers suggests that the choice of men for settlement has been based on medical considerations and not simply upon the man's capacity for work.

The proportion of advanced cases sent by Local Authorities with a view to ultimate settlement has been high. The Medical Director points out that " the chance of settlement should be offered to men whose disease is such that they could not earn their living in the outside world, and who might be a constant source of danger to others owing to their degree of infectivity. A Settlement, however, cannot be expected to accept cases whose disease is such that they require continuous treatment, and who are quite incapable of earning a living even under the specially protected conditions provided by the Settlement."

MEETINGS OF SOCIETIES

THE TUBERCULOSIS ASSOCIATION

THE provincial meeting of the Association opened at Cambridge on Thursday, April 2. After luncheon at St. John's College the first session began in the physiological school with a paper by Dr. R. H. Hazemann of Paris on the Dispensary Organisation in France, with special reference to the administrative department of the Seine. The objects of the dispensary are to detect early tuberculosis and arrange for the admission of patients to suitable institutions. They examine contacts and send health visitors to the homes. No treatment, however, except pneumothorax refills, is carried out by the dispensaries.

Ninety per cent. of the dispensaries of the Seine have screening apparatus, and the tuberculin test is used extensively. There are 821 dispensaries with 1,323 dispensary health visitors; 156 public, 19 hospital, sanatoria; and 214 preventoria. The deaths from tuberculosis of all forms in France during the year 1931 numbered 63,453, and the number of tuberculous patients on the books was 259,197.

Dr. Haynius van den Berg, director of the tuberculosis service at Amsterdam, then read a paper on Dispensary Organisation in Holland. The antituberculous campaign in Holland consists of one National Association which deals with propaganda, the training of visiting nurses and tuberculosis research; eleven provincial societies which manage the dispensaries (in large areas the province is divided into districts with one central dispensary; each central and many branch dispensaries have X-ray apparatus); eight to nine hundred local societies which carry out the prophylactic and social measures under the tuberculosis officer. The dispensaries give no treatment whatever and notification is not compulsory. They arrange for the admission of patients to institutions and keep them under supervision on their discharge. The Grancher system is not practised in Holland, but infants in contact with an open case are vaccinated with B.C.G. The death-rate from pulmonary tuberculosis in Amsterdam is 3·4 per 10,000 inhabitants.

Dr. N. Tattersall, tuberculosis officer at Leeds, said that the dispensary was but a part of the tuberculosis scheme. At leeds a central dispensary

was provided with facilities for X-ray examination, and treatment was undertaken. Thus artificial pneumothorax, light, tuberculin and other methods of treatment were available, and a large city sanatorium and several hospitals were at hand to offer institutional treatment. There is close co-operation between the dispensary and institutions and between general practitioners and school medical officers at Leeds. In the case of contacts an attempt was always made to trace back the source of infection and not merely to detect the early case.

Dr. Russell Reynolds gave an interesting demonstration of cinematography of chest cases. The contractions of the heart in health and disease were shown on the screen, and a film devoted to the various lung conditions was very instructive, perhaps the most striking feature being the degree of movement with respiration of a lung half or more collapsed by pneumothorax.

In the evening the annual dinner was held in St. John's College, and afterwards members of the Association met in the Common and Music Rooms, which had been put at their disposal by the kindness of the college authorities.

On Friday morning the meeting was held in conjunction with the International Care Committee of the Union International contre la Tuberculose. Dr. Burrell read a message from Professor Bezançon, who was prevented from attending the meeting. He referred to the success of Sir Pendrill Varrier Jones in originating and developing Papworth, and remarked that " the English experiments of Papworth and Preston Hall are for all nations a splendid example which should be followed. They are the indispensable complement of the fruitful antituberculous work of the dispensary, for which we are also indebted to Great Britain, since it was at Edinburgh in 1887 that Sir Robert Philip created the first dispensary and also introduced into the antituberculous campaign a truly social as well as medical spirit. Nearly every country possesses dispensaries, but a few privileged ones only have their Papworth."

Dr. Maurice Davidson spoke on the Capacity for Work in Pulmonary Tuberculosis, and emphasised the necessity of regarding the upper middle-class patient as well as the industrial worker. It is fatuous, he said, to give indiscriminate advice about getting an open-air job. It is an obvious mistake to turn a bank clerk into an agricultural labourer, and the opposite of turning a manual worker, used to strenuous exercise, on to some sedentary pursuit may be equally inadvisable.

Dr. L. B. Stott, Medical Officer at Papworth Village Settlement, said that during the acute stage of tuberculosis a patient was obviously unfit for work, and when the focus was quite healed his capacity for work was normal. The problem was to decide to what extent should work be limited during

the various stages of healing. Physical signs show merely the present state of the patient and may enable the physician to form the opinion that he is able to work at present, but if the signs alone are sufficient to indicate that he is unable to work the prognosis is bad.

Dr. E. Bachmann (Switzerland) said that a training centre was established for the Canton of Zurich four years ago. It consisted of an administrative block, hostel and workshops. The main industries were gardening and carpentry. Under this scheme training was separate and under a different board of control from that of the sanatorium treatment, but close contact was kept between the two as there was a constant interchange of patients fit for training from the sanatorium to the colony, and from the colony to the sanatorium by patients who owing to a breakdown were unable to work in the colony.

Professor Von Weiszaecker, Director of the Medical Clinic, Heidelberg, said the after-care movement seems to be the result of a conception of medicine which affects not only the tuberculosis question but the whole field of therapy. My present task is therefore to show how my own work and experience in internal medicine, and neurology in particular, admit of comparison with your work in tuberculosis. The after-care movement appears to be the outcome of a system of social medicine and the recognition of the social diseases. Not only do we require "What does the patient need?" but "How does the patient live?" We want to know not only which remedies will relieve his symptoms, but how society should behave towards the sick man. Moreover, we are concerned with these questions not only privately as individuals, but politically as a nation.

As a matter of fact in many cases there is a gap between hospital and employment which neither practitioner nor house physician can fill. A man has concussion and remains two months in hospital, where he cannot get well because he cannot get work. But when he goes home he is still unable to make complete recovery because he is still unfit for normal employment. So he lounges about, obtains bromide and grows worried, listless, and bad tempered. At the end of four months his state of health is worse than it was on discharge two months previously. This condition we call the secondary disease. But if six weeks after the accident we can employ him as a locksmith (supposing he is a locksmith), we observe that although he does nothing for the first three days, on the fourth he begins to take an interest in his job, with the result that in two or three weeks his capacity for work is completely restored. In such a case therapy requires two or three months, whereas without the stimulus of work it would have taken six to ten months, or perhaps considerably longer.

This type of case is very common in my country. It is common in any

country with much unemployment, with the decrease of which it becomes rarer. But where is the country without unemployment?

As a rule patients with secondary symptoms used to attend either our clinic for internal medicine or our neurological clinic. No matter whether the primary malady were tuberculosis, an ulcer, or sciatica, we described the secondary disease as neurosis and began systematic therapy. The situation was paradoxical, for although the predisposing factor was psychological, the most suitable treatment was not psycho-therapy, which was only employed inadvertently. Although the cause of the secondary symptoms was a sense of insecurity and futility coupled with fatigue of the will-power, in most cases the patients were not constitutional psychopaths or neurotics, for their secondary symptoms had developed under peculiar circumstances. The decisive factor was the interruption of the placid stream of their social existence by disease or accident. The cause of the secondary symptoms consisted not in a positive external influence, but just in the negative fact of that rupture of a life's co-ordination in work, wage-earning, respectability, and physical enjoyment. We regard the "interruption factor" as the origin of the secondary symptoms, and this is reinforced by a number of typical conflicts of a more or less social nature. The most frequent of these are the following:

1. Unemployment with its attendant poverty and loss of that sense of security which is based on regular employment and respectability.

2. Dispute with a superior, ill-treatment, political antagonism.

3. Litigation with the insurance company or other adversary, in which the patient is contesting only for his right, as such and not for material advantage. We call this "legal neurosis."

4. Family quarrels, particularly with the wife's parents or with the wife, sexual conflicts and erotic liability.

When we realised the significance of these or similar factors in the treatment, not only of neurosis and incapacity for work, but even of organic disease, we found it difficult to decide how far the physician is qualified to interfere in relations which are partly public and partly private. Generally speaking, I regard interference as inevitable and justifiable, but time does not permit me to discuss the method even shortly.

On the other hand, these circumstances give rise to two series of questions which I should like to put before you in brief. One question is: What light does such experience throw on functional capacity and physiology of labour and on pathology? The second question is: In a socially minded state how must a system of insurance be organised to obviate the so-called secondary disease? In regard to this second question my remarks will be based mainly on experience in Germany.

My reports deals with both questions in detail and shows that the definition of work is only to a certain extent a question of physiological economy. It must be noted that even in the case of certain forms of manual labour the quality of the work (*i.e.*, its exactitude or beauty) is of greater importance than the output of physical energy required in its performance. On the other hand, capacity for work is never a question of physiological economy, but of will-power. The will to work is governed by external conditions of which we have already spoken. It is therefore not surprising, although it is very interesting, that neither the economic quotient nor the basal metabolism nor the absorption of oxygen show characteristic alterations in the case of the tuberculous patient with impaired working capacity. Thus we were unable immediately to estimate capacity for work from physiological figures.

In regard to social insurance we have three suggestions to make:

1. The system of special insurance rates for special injuries, and for accidents in particular, has from the medical point of view a great advantage. We are of the opinion that national health would benefit by a comprehensive scheme of insurance.

2. It is also a disadvantage when a system of insurance is based upon the quantitative assessment of injury (for instance, the loss of an arm 50 per cent. decrease in earning capacity). By a better scheme benefits would be assessed, not according to the extent of injury, but according to financial needs. Furthermore, the provision of suitable employment is obviously better than purely financial assistance.

3. The legal administration of insurance is not as good as the practical organisation of after-care, national health, and supply of work.

In the afternoon a reception was held at Papworth Village Colony and a tour made through the various workshops and buildings, including the new surgical block. After tea in the Hall papers were read by Dr. Bronckhurst and Dr. Pattison and a film of Clair Vivre shown. In the evening films of Leysin, Berg en Bosch and Papworth were shown in the physiological school at Cambridge.

On Saturday morning, April 5, Professor Sayé of Barcelona read a paper on Chronic Miliary Pulmonary Tuberculosis. The condition is characterised by its slow and irregular course, resistance to treatment, physical signs almost exclusively those of apical fibrosis, and X-ray picture of fine nodules scattered over the lungs. Complete resolution might occur. He described five forms:

1. The chronic miliary tuberculosis of the primary infection. This may resolve altogether in spite of an X-ray picture of miliary disease, or lead to a fatal issue, usually as a result of meningitis.

2. Chronic generalised tuberculosis, which is associated with non-

pulmonary lesions, but with pulmonary involvement in the later stages, and ends fatally.

3. Chronic miliary tuberculosis, which may resolve even after four or more years.

4. Localised hæmatogenous tuberculosis, which resembles fibro-caseous tuberculosis and becomes generalised only towards the end.

5. Non-apparent forms which are found by X-ray examination.

Rest under suitable conditions is the best treatment, and healing is sometimes helped by sanocrysin.

Three clinical cases were then presented for discussion, the first by Dr. S. Vere Pearson, the second by Dr. Hebert, and the third by Dr. S. Vere Pearson and Mr. H. P. Nelson. A very interesting discussion of each case then took place in which many members joined.

At the annual general meeting which followed, Dr. S. Roodhouse Gloyne was appointed President; Dr. L. S. T. Burrell, Vice-President; Dr. W. Brand, Hon. Treasurer; and Dr. F. R. G. Heaf, Hon. Secretary.

A meeting of the Association was held at Manson House on Friday, May 15. The afternoon session was devoted to a discussion on Climate in its Relationship to Tuberculosis. Sir Leonard Rogers, who read the opening paper, said that tuberculosis was a far more serious problem in India than was commonly believed, and 60 per cent. of tuberculosis deaths occurred during the hot season. He regarded a warm, damp climate as bad. Rain-bearing winds appeared to have a direct effect on tuberculosis. In those parts of Devonshire protected by the Dartmoor hills the death-rate from tuberculosis was considerably less than in those districts exposed to the westerly rain-bearing winds. The same thing was found in districts protected by the Exmoor heights, and also in India it was found that rain-bearing winds rather than actual rainfall affected the tuberculosis death-rates. Altitude had little effect on the incidence of tuberculosis.

Dr. Andrew Morland said that altitude played but a small part in the incidence of death-rate from tuberculosis, and as regards treatment a careful selection of cases should be made. The dry, rarefied air of high altitudes was beneficial for some but harmful for others. He also pointed out how opinions changed as regards the effect of climate. In France a maritime climate was considered beneficial, but now the general opinion is that country in close proximity to the sea should be avoided. It should be borne in mind that residence in one district was not necessarily beneficial because improvement followed a temporary visit there. It was often the change that caused the improvement.

Dr. Basil Price and Dr. Sandison described the work that is being done at the Ministry of Pensions in relation to climate and tuberculosis. Although

the majority of pensioners were treated in this country, a considerable number were sent to Switzerland and some to other foreign resorts, chiefly the South of France. The result of treatment of these groups was being noted, and at present it would not appear that any advantage was obtained by treatment out of this country.

In the evening session Mr. J. E. H. Roberts read a paper on Recent Advances in Thoracoplasty and Adhesion Section. He illustrated his remarks by a number of X-ray slides showing how it was possible to get good results even when adhesions were large and numerous. Personally he advocated using a separate thoracoscope and cautery. Complications of the procedure were rare, fluid being the least uncommon; this, however, was not found in any great quantity, but it sometimes led to obliteration of the pleural cavity and therefore needed watching. He emphasised the importance of keeping up refills after the operation in order to prevent the pleura from becoming adherent. In his opinion it was most important that the cauterisation should be undertaken in a well-equipped theatre where facilities were at hand to stop any serious bleeding such as might follow injury to the intercostal nerves.

Dr. F. G. Chandler described his method of dividing adhesions, and advocated a single cautery and thoracoscope, and thought it best to use both diathermy and the ordinary cautery, and he had found it advisable to coagulate with diathermy. In his opinion bleeding could be stopped by diathermy, and he quoted Maurer as having said it was possible to cut through an intercostal artery and stop bleeding by diathermy. His paper was illustrated with several excellent diagrams and films, and a discussion followed in which many members took part.

REVIEWS OF NEW BOOKS

Diseases of the Nose, Throat and Ear. Edited by A. LOGAN TURNER, M.D., LL.D., F.R.C.S.E. Fourth Edition. John Wright and Sons, Bristol. Pp. 473. Price 20s.

The first edition of this textbook appeared in 1924 as a joint work of those engaged in the teaching and practice of the speciality in Edinburgh. It has since run through three editions, and this new issue, which has become necessary to keep in line with new work, will certainly have the popularity of the previous ones.

It is intended as a practical handbook for students and practitioners, and throughout maintains this standard. In a work of this size there is rightly a great deal that lies in the province of the expert only that is omitted, and theoretical discussions are left almost entirely to the larger and more specialised textbooks. It is surprising how completely the field of practical work in the speciality is covered, and throughout the work is clear and succinct and the illustrations good.

Separate chapters are now devoted to nasal polypi and to allergic conditions, and more might have been made on the latter subject in view of its great importance.

The sections on tuberculous conditions are excellent, and tuberculous laryngitis is discussed adequately. Conflicting methods of treatment are discussed impartially, emphasis being laid on the importance of general treatment, though this is not fully considered, being outside the scope of the book.

This will again be one of the most popular books for the student.

Investigationes sobre la acción del tiosulfato sódico en la tuberculosis. By C. XALABARDER. Trabajos relativos al tratamiento, diagnostico y profilaxia de la tuberculosis. Vol. 2. Barcelona, 1935.

Dr. Xalabarder and his co-workers believe that any good effects that have been obtained by sanocrysin therapy are not due to gold, which they look on as a useless poison, but to the thiosulphate part of this salt. They claim that with sodium thiosulphate the beneficial effects on the tuberculous process may be obtained without the risk of toxic reactions and at a much lower cost.

Sanocrysin is stated to decompose, immediately on coming into contact with the blood, into sodium thiosulphate and gold ions. The latter are strongly tonic, but their action is greatly reduced by the presence of sodium thiosulphate, which is also able to prevent the death of an animal injected with a lethal dose of chloride of gold.

In support of their theory that sodium thiosulphate has a direct action on tuberculous tissue, the writers describe experiments in which a transitory hyperglycæmia was found to follow the injection of this salt in tuberculous, but not in healthy subjects. A similar rise in the blood sugar has been found after the injection of sanocrysin or tuberculin, especially in cases where the lesions are closed and the toxic products of the disintegration of tuberculous tissue cannot escape by the respiratory tract. Other experiments are recorded to show the stabilizing effect of injections of sodium thiosulphate on the metabolism of glutathion and their influence in facilitating the reducing power of yeast and liver extract.

However interesting the experimental basis of thiosulphate therapy, it will be on its clinical results that judgment will have to be passed. Owing to an insufficient supply of hospital and sanatorium beds, more than three-quarters of the tuberculous patients in Barcelona have to be given ambulatory dispensary treatment, most of them remaining at work, quite unable to obtain rest in bed, and most of them suffering at the same time from malnutrition and insanitary housing conditions. Dr. Xalabarder considers that such patients provide a severe test for any method of treatment, as in such surroundings the disease would rarely tend to heal spontaneously. These 652 patients receiving thiosulphate treatment while continuing their work were divided into two classes. In the first group were 63 cases with the disease so advanced that only temporary amelioration of symptoms could be hoped for; of these 28·5 per cent. showed a favourable response to treatment, 23·1 per cent. losing the tubercle bacilli from their sputum. Group B consisted of 589 patients, only 26·2 per cent. of whom were T.B.; 88 per cent. responded favourably, and 39·3 per cent. of those positive lost their T.B. Considering the two groups together, 63·2 per cent. gained weight, 20·2 per cent. lost, and 16·6 per cent. remained stationary.

Although these results are sufficiently interesting to warrant further investigation, their value is reduced by the large percentage of T.B. cases included, many of whom appeared to have a purely radiological lesion, the writer himself describing them as in the preclinical stage. In view of this fact and of the absence of any information as to the duration of the beneficial effect of the sodium thiosulphate injections, the writer's claim of 90 per cent. favourable results must be received with some reserve.

Peeps on the Nursing Trail. By DERRY DOWN. John Bale, Sons and Danielsson, Ltd., London, 1936. Pp. 174. Price 3s. 6d.

This little book will be read with enjoyment by all who are acquainted with hospital routine. It is full of humour and yet gives a vivid picture of the life of a nurse. Much useful advice is given, and as Mrs. Rome says in a foreword, the book will bring the desire to many to enter the nursing profession.

A patient, says the author, is not merely a piece of furniture to be kept clean, and throughout the book there is an atmosphere of humanity and understanding. We are told that no one who does not really enjoy the duties of a sick-room is fit to be a nurse.

The chapter on private nursing shows how different it is from hospital work, and it certainly needs tact and patience to succeed. The proceeds of the sale of this book will most generously be given by the author to the Home for Tuberculous Nurses which is being started at Papworth. Those who purchase this little volume will not only support a good cause, but will get more than their money's worth from a bright and entertaining account of the joys and sorrows of nursing.